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ABSTRACT

This document contains five case studies of plants within large enterprises in the automobile industry (Ford, Toyota, Volkswagen, Renault, and Volvo), plus reports of each company's views on human resource development, new technology, and changes in work organization and skill formation. The document is composed of five narrative sections, references, and an appendix. The first section sets the case studies within the context of a larger study of technological change and industrial restructuring. The second section describes the rationale and methodology used and reports the findings of the case studies from plants in the United States, Japan, West Germany, France, and Sweden. The third section discusses the following topics: (1) technology in the automobile industry; (2) the process of technological change; (3) management change and the proper use of technologies; and (4) technology as an instrument for managing change. The fourth section examines employment and work organization, including the impact of economic conditions, the importance of internal labor markets, health and safety considerations, and the question of job satisfaction. The fifth section discusses training and education, pointing out that the issues related to the current situation go beyond purely vocational training and involve education in the broader sense. Eight references are cited. The appendix contains detailed descriptions of the five companies that participated in the study. (CML)

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NEW TECHNOLOGY AND HUMAN RESOURCE DEVELOPMENT IN THE AUTOMOBILE INDUSTRY

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and Innovation

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NEW TECHNOLOGY AND HUMAN RESOURCE DEVELOPMENT IN THE AUTOMOBILE INDUSTRY

Within the CERI project "Changes in Work Patterns and their Educational Implications" a number of research studies on the development and use of human resources -- with particular focus on skill formation -- in the context of technological change and industrial restructuring have already been undertaken. An important part of these research studies focused on five large enterprises in the automobile industry (i.e., Ford, U.S.; Toyota, Japan; Volkswagen, Germany; Renault, France; and Volvo, Sweden).

Specific case studies at the plant level in each of these enterprises were undertaken by highly-qualified researchers. Parallel to these case studies, each of the participating companies presented a report giving the company's views on human resources development, new technology and changes in work organisation and skill formation. The study presented here is a synthesis of the different case studies by the researchers and the reports by the enterprises.

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III. Volkswagen (Germany)

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I. CONTEXT OF THE STUDIES

This series of studies is an important component of the CERI project "The Development and Utilisation of Human Resources in the Context of Technological Change and Industrial Restructuring". As scarcely needs stressing, these changes are profoundly transforming industries and occupations, and, while a great number of jobs have disappeared and others have been newly created, many places of work and the skills deployed there have undergone important changes as well. All these developments imply a major challenge in the provinces of education and training.

The working objectives of the CERI project are, therefore:

-- To examine the ways in which human resources are developed and utilised under changing economic, social and cultural conditions;

-- To elucidate the roles played by the various agents of influence in governments and in enterprises, and by the formal education and training sectors; and

-- To propose options for improving future human resources policy.

The project is structured around three major components, or Parts:

Part I:

a) Theoretical Review

Analysis of the various concepts of human resource development in their relationship to structural and, in particular, technological change, with a view to elaborating a conceptual framework.

b) White-Collar Study

The principal focus of the case studies in Part III below is blue-collar workers and different groups of technicians. A second survey study has therefore been undertaken on the impact of new technologies on white-collar workers in terms of their work patterns, qualifications and education and training needs.

Part II: Country Reports

Description and analysis of recent and emerging national policies on human resource development as they relate in particular to education, training, and enterprise strategies.

Part III: Case Studies

Case studies in five automobile firms (Renault, Volkswagen, Toyota, Volvo, Ford). Each study has two, separately conducted, components::

a) Company Report

A statement by the enterprise of its human resource policy, including a description of relevant technological innovations and the company's response to them in terms of work organisation, education and training.

b) Research Report

A study carried out by a research team of national specialists, based on interviews with a cross-section of the enterprise personnel (senior management, training personnel, union representatives and shop-floor employees) and focusing on new technology and its impact on work patterns, education and training.

II. THE CASE STUDIES IN THE AUTOMOBILE INDUSTRY

1. Rationale

Obviously, structural and technological change affects all sectors of the economy and the impact of these changes on employment structures, skill requirements, and perceived training needs, is different not only from industry to industry but also within industrial sectors, depending on such factors as the skill profile of the workforce, the size of the enterprise, the scope and the rate of change within the enterprise as well as on the management of the change process and the role of industrial relations in it.

In spite of the inherent difficulties with case studies due to this complexity of variations, there was never any doubt that specific enterprise studies would be needed if a realistic analysis were to be made of the role human resources play in the process of change. There were two principal reasons for this. One is that they would provide a real-life background for the issues and policies to be addressed theoretically in Part I and nationally in Part II of the project. The other is that, although the skills and other qualities deployed in an enterprise ultimately depend on the overall structure of the economy and the labour market, it is crucial to know what scope there is for individual choice in the introduction of a technology, the organisation of work and the utilisation of human resources.

The automobile industry was selected for this study for a number of reasons. It is in the forefront of technological change, as the major user of robots and other automated or semi-automated production systems. It is an industry central to many of the OECD economies, in terms of its own output and employment levels, and the demand it creates in related sectors. And it is a worldwide industry, with an intensive interchange between countries of

products and techniques. From such a single industry, while not representative for other industries or sectors, one might expect a certain degree of uniformity which would allow for an inter-country comparative analysis.

2. Research Sites and Units

Five major automobile-producing companies agreed to participate in the study:

-- Ford Motor Company (U.S.A.)
-- Toyota Motor Corporation (Japan)
-- Volkswagen/Audi (Germany)
-- Renault (France)
-- Volvo (Sweden)

Four of these are among the leading world car producers with respect to the number of cars produced (cf. Table 1), while Volvo is notable for the far-reaching changes in work organisation it brought about in the 1970s.

Table 1

LEADING WORLD MANUFACTURERS OF PASSENGER VEHICLES

	Production 1981
General Motors	5 499 330
Ford	3 097 249
Toyota	2 395 390
Nissan	2 105 702
Volkswagen/Audi	2 023 614
Renault	1 607 818
Peugeot-Citröen-Talbot	1 579 193
Fiat	1 171 544
Chrysler	869 797
Honda	852 177
Toyo Kogyo (Mazda)	840 630

Source: OECD, Paris, 1983: Long-Term Outlook for the World Automobile Industry.

In accordance with the planned structure of the study, two reports emanated from each of these companies. One was by the enterprise itself, covering human resource policy, a description of relevant technological innovations and the company's response to them in terms of management, work organisation and education and training. The second report was a research

study carried out by a team of academic and other specialists from outside the company. The actual workplaces covered by these teams were: the Renault plant in Le Mans, the Volvo plant in Olofström, the Volkswagenwerk in Hanover, the Tsutsumi-Toyota plant in Nagoya and the Ford Dearborn Engine plant.

Each of the national research teams concentrated on a "functional unit" within the plants chosen. The criteria for the selection of these units were that they should form part of the production process and involve mainly manual workers. The unit should be where there had been some measure of substantial technological change, with implications for the organisation of work and the skills required. It should not, however, be fully automatised and require only maintenance workers to function. In other words, production workers might be fewer in number and have different functions to those they had before the innovation, but they should still be present. 'Unit' should be broadly rather than narrowly interpreted to refer to any identifiable stage in the production process.

Although at first view these criteria might have facilitated a comparative analysis, the units selected for research proved to be insufficiently similar on account of important differences between plants as to production equipment and work organisation. However, as is explained below, all of the units chosen were operating roughly within the same stage of the production process. Thus, the United States team focused on a crankshaft production unit, the subject of the Renault study was a stub axle carrier shop, the units chosen at Toyota and Volvo were press shops, and at the Volkswagen plant a body shell assembly was selected.

3. The Methodological Tools of the Research Studies (1)

There was no chance (within the allotted timetable for the study) of carrying out rigorously controlled analysis, or of decisively confirming or rejecting tightly framed hypotheses. What was needed was a reasonably clear account of where one might expect variations to occur, and of how such variations could be linked to an analysis of the effective use of human resources. Ideally one would wish to have a defined statement of the objectives of human resources policy and an assessment of the extent to which those objectives have been achieved in the different companies. This would then allow an analysis of the factors which explain variations in the degree of success achieved. In practice, it was soon clear that there were so many other factors intervening that the contribution of human resource policy would be difficult to isolate in the way that this implies. At this point, therefore, we should take a brief look at the methodology applied by each research team to see what special influence it might have had on the outcome of the study.

In designing its research project, each research team selected a different mix from the range of tools available to them: different degrees of emphasis were placed on interviews, surveys, direct observations of operations, literature reviews, and company documents. There was also variation in the application of these tools: for example, the setting and length of interviews, the number of people (interviewers and subjects) present, or the selection of survey samples. Each team also set up its own

division of labour. Such factors provide a partial explanation for the differences in style, subject matter, findings, and conclusions between the five reports.

The German report provides the fullest description of the methodology applied. The study had two bases for information: interviews and documentary materials. The latter were collected from different Divisions in the company that were involved in the change process. For example, the Personnel Division provided information relating to personnel changes. The bulk of the data, however, came from interviews with rank-and-file employees, management personnel and works council representatives. The research team talked with 36 "change agents": that is, people "who participated in the decision-making and problem-solving process while planning and implementing new technologies or who are today working within the new systems in the body shop". These 36 people participated in individually administered, structured interviews which stressed "the interests, strategies and actions of staff and line personnel who participated in the process of computerising the assembly lines".

The rank-and-file interviews were a stratified, statistically non-representative sample of 164 workers in four categories: workers in conventional assembly, in automated areas, those facing automation, and those who had lost jobs as a result of automation. The intention for this part of the study was not to create a representative sample, but to establish "a sufficiently numerous group for every characteristic work situation" in order to "permit statements related to differences in types" of workers and work situations.

The workers' interviews were also individual, structured interviews. Most, except for maintenance workers, were administered in the respondents' homes. The interviews primarily focused upon skill changes and the acquisition of qualifications to use the new system. Workers and interviewers also discussed the problems associated with these changes. The results of these interviews were subsequently subjected to statistical analysis and composed into the tables which comprise the bulk of the appendices.

The methodology used in the Japanese report was similar to the German. Research was based on shop-floor observations, and an extensive closed-question survey of lower-level employees. At the outset the researchers interviewed 60 management, education and training, and engineering personnel at corporate and plant levels, along with twelve rank-and-file workers. In the light of these interviews, and in consultation with the Training and Education Departments, the research team designed a survey intended "to clarify the adaptation of workers and engineers to the introduction of new technology". 380 shop-floor workers and 90 engineers responded to this survey, the results of which were tabulated and presented in the appendices to the report.

The Swedish report on Volvo depended heavily on in-depth interviews with 27 key informants. A "key informant" was identified as "someone with a good overview of what has been going on in the company and with a grasp of the dynamics (political, social and economical) behind it". Initially, the interviews were semi-structured; later, interviewers found that subjects were more responsive to an open-ended format because they had felt constrained by the preconceived framework. The researchers also used transcripts of

interviews conducted by other research teams to augment their set of interviews. Finally, they drew information from eleven other reports (in-company and consultants') on the Olofström plant where the study was conducted, and on Volvo in general.

The United States report also relies quite heavily on interviews for the bulk of the information. In all, 87 Ford employees were interviewed: 40 hourly production people (the entire production staff of the DEP crankshaft area), 6 hourly maintenance and skilled trades people, 3 union representatives, and 38 salaried employees from various levels within the company and plant. Although questions were prepared in advance (and, in the case of management personnel, submitted to them prior to the interview), for the most part interviews were open. They were conducted at the worksite individually or in small groups by one or two (occasionally three) team members. The team itself had been divided into three groups, each concentrating on one component of the project: new technology, work organisation, or training. Although working separately, each group also collected data for the other.

The French report made some use of observations, interviews, and company documents. The final mix of these tools, identity of the interviewees, or the weight given to documentary materials, however, are not detailed in the report.

Although each national research team used interviews as a central part of their methodology, they did not all use them in the same way. Closed interviews, like surveys, focus on a specified set of issues and concentrate on extracting as much relevant detail as possible. Open interviews, on the other hand, may capture a wider range of information, but lack the same depth. Furthermore, closed interviews assume a theoretical orientation at the outset: researchers have a fairly specific idea of the kind of information they need in order to prove or disprove their expectations. Although without a formal theory at the outset, the German study is of this type: the team assumed the importance of a certain set of factors as determinant of Volkswagen human resource policy and of workers' reaction to change and, therefore, focused on those factors when setting up the interview schedule.

The Swedish team, on the other hand, took a "grounded theory" approach, in which theory is built simultaneously with analysis. The open-ended discussion format which they ultimately used lends itself to this kind of theory building. In a sense, then, the German report was more "compact" and focused, and able to provide considerable detail regarding certain issues, while the Swedish study was more wide-ranging.

Only the German researchers say they conducted interviews away from the worksite. The interview site may have an important influence on the nature of interviewers' responses. At the worksite, workers may feel constrained or hesitate to be open with the interviewer. None of the research teams, however, seem to have experienced this problem.

Interviewing in teams can either dampen or stimulate discussion. Employees may feel inhibited to speak openly in the presence of others. Alternatively, they may find discussion more comfortable with their colleagues present; and such a group may have the effect of prompting the ideas of

individuals. The United States team used both individual and group interviews but did not comment on which method, if either, was better. In any case, it is not too likely that information became significantly distorted.

The Japanese team was the only one to employ a formal survey. Surveys have an advantage in that it is possible to gather the opinions of a large number of respondents. This one was administered to all of the employees in specific work units; they, then, could make definitive statements about the attitudes of workers. On the other hand, they were restricted to statements only about the topics in the questionnaire. Interviews allow more freedom in that the interviewer may pursue issues as they come up and probe for details which could not be captured in a questionnaire. Usually, however, because of the time involved in conducting open interviews, this method only allows a certain degree of generalisation and does not permit definite statements regarding the perceptions of respondents. In the United States study all of the employees in the crankshaft area were interviewed. This, however, was only a small unit in a large plant, which was only one in a major corporation. Their conclusions cannot, therefore, be taken as generally applicable.

In selecting between methods, something is usually lost while something else is gained, as for example in the choice between open or closed interviews, or survey method. Other factors that influence the shape of the final product include the researchers' purposes (e.g. description vs. analysis), constraints (e.g. organisational, temporal, financial), personal interests, and social conditions (e.g. the importance of the German qualification system probably influenced the decision to focus attention there). Thus, while at the outset the directives and purposes for the research studies were the same, other factors then combined to produce the altered shape they finally took.

4. The Main Findings: Human Resource Development and Technological Change in Five Major Automobile Companies (2)

It is the present intention that all the case studies (i.e., the five research reports as well as the corresponding five company reports) should remain restricted in their integral form to the researchers and companies directly involved in their preparation. Before we attempt an intelligible analysis of the totality of their findings, we must, therefore, present summaries for each country separately, integrating the company with the research reports. A brief description of the main characteristics of the companies can be found in the Annex.

a) Human Resource Development at the Ford Motor Company and the Ford's Dearborn Engine Plant

In the 1970s, the Ford Motor Company was faced with a glaring need to make fairly drastic changes not only in its products, but in its work organisation and production methods as well. Sales were down and the Company was under severe economic pressure. A new economic environment in the form of fierce foreign competition, recessions, and a slow growth market for automobiles along with changing consumer demands stimulated management's efforts to introduce new product, process, and management technologies.

Although technological changes have not been insignificant, some Ford managers have claimed that the most important changes have been in management style. The key elements of this new style are collaborative efforts of labour and management and active involvement in the labour process by all affected groups. The goal has been for workers and managers to join efforts and together create an automobile corporation that is "the best in the world".

In partial response to the intensely competitive climate of the late 1970s, Ford senior management issued four Policy Letters relevant to technological innovation and human resources. These letters, intended to communicate the new direction established by management, were on Durability, Quality and Reliability Excellence; Employee Involvement; Technological Innovation; and Productivity Improvement. In particular, the Letter on Employee Involvement stated:

> "Management systems, procedures, and practices should take into account that human resources are among the Company's most important assets.
>
> Methods of managing should encourage employee participation in identifying and solving work-related problems.
>
> Communication programmes and procedures should be implemented that encourage frequent, timely and constructive two-way communication with employees concerning work-related problems. Employee work suggestions and ideas should be solicited, and employee questions should be answered as completely as possible."

Management has come to acknowledge the critical role played by human resources in the success or failure of the Company and, thus, the need to develop those resources to their fullest possible potential. This was highlighted in a speech by the President of the Company, in which he said: "Certainly we will be measured by how well we handle our financial resources, the financial bottom line, but in addition we will now also be measured by how well we handle our human resources, the 'social bottom line'".

This development requires change. Participative management -- the "new style" -- is a phrase commonly heard at Ford today. Essentially, it means delegating decision-making and problem-solving authority to lower levels of the organisation. It means taking seriously the workers' contributions to planning and implementation processes. It also means, ultimately, the loss of a few layers of management and a greater sharing of control and responsibility.

This shows a clear contrast with the past attitude of the Company; during the 1970s, as against the management research and the emerging participative management, Ford had moved only moderately from the "scientific management" practices of Taylor. In the late 1970s, the company and the union became keenly aware of worker dissatisfaction, work alienation and changing worker values. As a result, a joint initiative was taken between Ford and the UAW to begin creation of new work climate and relationship.

A major mechanism of participative management has been the Employee Involvement Programme (EI) mandated by union/management agreement at the corporate level. The form of the programme and its implementation is left up to plant and union local personnel. It was hoped that EI would help reduce

dissatisfaction and alienation among workers and positively change their attitudes towards the job and the Company. EI provides workers with an opportunity for problem-solving while also offering a new arena for training. As part of EI, employees are trained in the principles of group dynamics, problem-solving techniques, communication, etc. It is aimed not only at organisational change, but attitudinal change as well.

EI has met with some success, but it has also encountered problems. One problem is the suspicion and scepticism held by some employees -- and not just those on the shop floor. Some blue-collar workers feel that EI is only a temporary measure to help Ford ease through difficult economic times. Among white-collar workers some mid-level people express uncertainties about the utility of EI because their job is being threatened or because no active role has been identified for them. A second problem is the occasional attempts of both union and management to hold EI "hostage" to bargaining demands or to use it in some other way to further their own interests.

Neither EI nor any other specific policy or programme relates work organisation directly to new technology. In a sense, the new management techniques are themselves a new form of technology. In general, management tries to retain and promote flexible work organisation in order to accommodate technological change. Training, too, is highly decentralised and designed to meet specific needs of plants or production units.

The newly renovated Dearborn Engine Plant (DEP), represents just one form taken by the organisation after the implementation of many of these changes. It was selected as the site for study because of the technological innovations introduced there and because managers were interested and willing to participate in the project. The "outside" research team concentrated on the crankshaft line which had been so automated that one person could do the work previously requiring eight. Furthermore, new programmable controllers have been installed to monitor the production process. These new forms of equipment and process technology created a need for a workforce with an entirely different set of skills than the ones already held at DEP. New technology, then, meant extensive training and reorganisation of the labour force.

There were many "firsts" at DEP. For example, the development of this new 1.6 litre "hemi" engine marked the first instance of human resources being specifically introduced into the decision-making process. They were brought in as early as the site-selection stage, and for two reasons: the complexity of the new technology and a new management policy to consider the human aspect of production. Another "first" was the pre-launch training of hourly personnel which resulted from their involvement in the pre-start set-up and qualification of equipment. To a degree, these "firsts" foreshadowed changes to come on a wider front, particularly the drive to involve workers in the work process.

In response to the needs of the new technology a new job description was introduced: the Automation Equipment Operator-Set Own Machine (AEO-SOM). The SOM is different from the previous machine operator in a number of ways. First, he is semi-skilled. He also sets up his own machine rather than having a job setter do it for him. In this respect he may be called a "generalist". Despite considerable automation and sophistication of equipment, the SOMs have

not been "deskilled" -- if anything their skill level has increased slightly. The type of skill has shifted, however, from "physical" to "mental". Workers may rarely handle the equipment, but human judgement is still needed to keep the line running. In addition to understanding the production equipment, they must also be able to use statistical process control (SPC) methods.

Their new set of skills has moved SOMs to a new place in the workplace hierarchy. They "are counted on by maintenance workers and engineers to explain the events preceding machine breakdown and to assist in diagnosing problems". They may also perform minor maintenance themselves.

Workers' attitudes towards their new form of work organisation has been generally positive. They take more pride in their jobs and are pleased with their increased autonomy. They are not pleased with every aspect of the job, however. Only half use SPC and a few feel they should be remunerated for this additional task. (Management argues that it is not "additional" but simply part of monitoring the system.) Some also find the job boring, especially when the machine is running well and there is nothing to do. Former skilled tradesmen, reduced to production work due to volume changes, are particularly negative, finding such work demeaning and routine. Those most interested and satisfied with the job are those who had been involved from the beginning.

Workers' attitudes towards new technology in general is ambivalent because they are aware of its potential threat to workers. They feel that new technology meant "someone will have to go". It also could mean a loss of autonomy. For example, workers resent a new computer programme which monitors and schedules tool changes. Previously, tool changes were up to the judgement of the SOM. This eliminated one of the few decisions left to them to make.

The new relationship between man and machine on the shop floor brought about a need for extensive training. Ford allocated an unprecedented $7 million for this purpose. Training began early. As soon as the technology was selected, the Training Launch Team, in consultation with division- and plant-level engineers and outside vendors, conducted a needs analysis. Training programmes were designed for production, semi-skilled, skilled, and supervisory staff, with an emphasis on training of the skilled group. But even machine operators received nearly 100 hours of orientation, in-house course work and vendor training. Topics included organisation, product orientation, plant operations, basic machining and tool control concepts, equipment training, safety, and minor maintenance. Most of the training was either self-tutoring or "hands-on" practical experience. For the most part Ford utilised in-house training resources, but a few workers, primarily from maintenance, were sent off-site for vendor training.

Supervisors also received several weeks of supervisory and technical training. The aim was not only to make them comfortable with the new technology, but also to acquaint them with the new management style. Experienced supervisors passed on their knowledge by assisting in the development of supervisory training programmes.

One interesting outcome of this training drive, initially designed to fit the specific need of one plant, is a permanent Learning Center located at DEP. It has an extensive inventory of highly specific and technical

programmes primarily for skilled tradesmen, and equipment simulators. It has become a prototype of other Learning Centers throughout Ford.

Management have used statistics to assess the impact of the training programme. They note that reject levels and downtime have been reduced and quality is up, though these results are not clearly attributable to training efforts. They assert that early involvement of workers is very beneficial.

Workers' assessment of training is not as positive. They question the relevance and adequacy of formal training. Those who received vendor training cite it as more important than in-house classroom training. Workers also stressed the greater value of their own experience and "the tricks of the trade" learned from other workers over Learning Center training. Researchers found that many factors influenced the efficacy of training as well as workers' assessment of it: "...whether workers pick up the know-how is at least partially affected by a variety of factors, including their assessment of the benefits of automation; their views on the efficacy of supervisory employees; and, in a subtle fashion, whether and what kind of training they receive".

There are several problems associated with the introduction of new technology. One stems from the collective bargaining agreement. The method of collective bargaining is a constraint in itself because certain changes in work organisation cannot be made without negotiations. Another constraint is the "bumping and bidding" system established in the labour contract. A laid-off worker in another part of the Rouge Complex of which DEP is a part can bump into his same classification in DEP if he has higher seniority. Because of this DEP may lose a trained worker, or a supervisor may hesitate to release this newcomer for training because he may yet be recalled to his old job. The unit, therefore, may not have the skill levels to be properly maintained.

The increased tension in supervisor/worker relations is another problem associated with technological change. Occasionally, supervisors, especially those new to an area, are inexperienced with the new equipment. This often means that mechanical problems are not solved quickly, either because the worker has to explain the problem to the supervisor or because the worker himself cannot diagnose the problem and cannot rely on the supervisor for help. Technically inexperienced supervisors are a source of frustration for workers and slow down the work process.

A third problem, which is certainly not new in Ford, is the sluggish flow of communication from the top down. Some workers complained that they knew nothing about what was happening at DEP until the machines arrived. They are also interested in how the plant is doing financially; but, they say, they get little information from management and do not trust what little they get.

For its part, management points to the manager's state-of-the-plant talks, the company newspaper, and the encouragement given to supervisors and superintendents to keep workers more in the picture as evidence that communication is improving. Many workers agree that it is better than it had been. While the Employee Involvement process would contribute to

communication, the extensive employee turnover due to seniority bumping systems has made sustaining any group activity difficult in this area.

In general, union/management relations have improved in recent years. But at DEP the union was only marginally involved as far as the selection of technology was concerned. However, the union vigorously lobbied to keep DEP open and participated in the administration of training programmes. Management retained a large measure of autonomy in making the major decisions.

Even accepting the considerable technological changes that took place at DEP, some managers say the most innovative aspects of the plant's renovation were organisational: principally, increased emphasis on participation and the new Learning Center -- in other words, the new management style. They felt that today it is "more important to make improvements in what you have rather than institute multiple and widespread new technologies". That includes human resource development. But for Ford the new management style is very new and it will be some time before the managers and the workers are fully comfortable with it.

b) Human Resource Development and Technological Innovation in Toyota Motor Corporation and the Tsutsumi Plant

The human resource goal at Toyota has long been total workforce participation based on mutual trust between labour and management. Severe industrial conflict in the years immediately following World War II almost resulted in the collapse of Toyota Motor Corporation. In consequence, union and management realised the need for co-operative effort as the only hope for the Company's survival. In 1962, therefore, they jointly issued the Labor Management Declaration which states in part: "The Company, realising that people are the basis of any firm's prosperity, will take the initiative in preserving and improving labour conditions. And the Union, cognizant of the necessity to improve quality and productivity, will give constructive co-operation to the policies of the Company in order to help it flourish." Information sharing and joint consultation have become key elements of decision-making and problem-solving processes throughout the Corporation.

Co-operation is a central principle in daily operations as well. For example, both blue- and white-collar employees work co-operatively in teams. Such teams are seen to be efficient units of production: "Workers are organised into groups which can process small volume and wide variety of products". The team is the smallest unit of co-operation and the smallest unit of cost accounting. At this level are calculated production volume, man-hours, cost reduction of materials, and number of defects. Production statistics of the team are sent to a central office for an efficiency evaluation. Each team's achievements are made public and compared to those of other teams. Any rewards for improvements are made to the team as a unit. The emphasis placed on the team as a unit, along with the fact that workers are often expected to stay within the same team throughout their careers, strongly promotes dedication to the team. The aim of this system is to make the individual's goals consistent with those of the team.

Worker/supervisor co-operation is also strongly encouraged. For example, when defects are found in a product, shop floor workers attempting to

correct the problem may have access to management personnel all the way up to section manager. In the case of the union, there exist channels of communication at the levels of operations, departments, plants, and company. Company, Union, and workers are active in promoting communication and co-operation at all levels.

Another characteristic of work organisation at Toyota is multifunctionality -- which means that a worker is able to perform several jobs. Multifunctionality has two essential advantages: for the Company, it permits a high degree of flexibility by raising the skill level of the workers so that management may deploy the workforce in accordance with the changing production volume; and, for the worker, it plays a major part in making him "promotable" by increasing his value to the company.

This Company policy is made evident in several ways. For example, job descriptions are quite broad, so that a worker is not confined to a single task. In fact, workers have no fixed work assignment and may change work areas within their teams every week. If a team's production quota does not require a full shift's work, the workers will be sent to support another line. In some cases they may even be sent to another plant for a while (this poses no hardships because most Toyota plants are located within a 20 kilometre radius). Increasing his level of experience is beneficial not only to the company but to the worker as well because one who has mastered many jobs is classed as a "multifunctional worker" and will be in line for early promotion. Salaries are then based on the level of the worker's job ranking plus ability, and are unrelated to his/her actual job duties.

Toyota's social management policies also stress developing in the worker a sense of dedication to and involvement in the Company. The Company sponsors and encourages groups such as the Friendship Organisation (a peer group), the Personal Touch Movement (aimed at bringing together superiors and subordinates), and Dormitory Groups. It also organises recreational activities. Again, this policy and its programmes have a dual role: they foster the individual's identification with the Company while developing his human relations skills. This latter is important when a worker is under consideration for promotion.

From the top, the Company pursues an active and conscious policy of social management which it treats as of equal importance to technological innovation. Co-operation lies at the core of the policy and is developed through the practice of multifunctionality, team work and quality control (QC) circles, and after-hours group activities. These practices apply to both white- and blue-collar employees. In fact, there is no clear demarcation between these groups -- they are treated in the same way by both Union and management.

Toyota's training programmes are designed to foster all these principles. A newcomer to a production unit in Toyota receives over three weeks' training before even receiving a job assignment: he spends two weeks in the Educational Department of the Head Office where he is introduced to topics such as management goals and policies, importance of work discipline, attitude and manners, and safety and health. Then he spends five days at the Production Department of the plant. Before being assigned to a team, he will spend two days training in his division. Once assigned, he will start by

learning simple tasks, later working up to more complicated ones. From this point on, the team will represent his primary training centre, as on-the-job training is a major form of education for employees. Even at the production level Toyota has maintained a form of master-apprentice style of training: for a year the new worker will be "tutored" by a senior member of his team or the team leader. The tutor not only teaches the basic skills, but also helps ease the new man into the new social situation -- in other words, he is helped both to learn multifunctional skills and to work within a group.

Training for white-collar workers is also quite extensive. For example, there are three aspects to the training of engineers: formal training, on-the-job (OJT), and self-tutoring. A new engineer begins with several months of general training after which he chooses an area of specialisation in which he receives further, practical training. This training will be guided by a senior engineer. Engineers also acquire OJT through job rotation within their work teams. Finally, in consultation with a superior, engineers will plan and carry out yearly self-tutoring schedules. It takes many years to become a full-fledged engineer: ten years for high-school graduates and six for those with university degrees. It is evident that, for Toyota engineers, on-the-job training and continuing education play an extremely important role in their career development.

Workers' perception of these underlying principles of work organisation and their associated job practices were analysed by researchers at Toyota as part of the OECD project on human resource development and technological change. The researchers conducted their study among blue- and white-collar workers. The blue-collar group was drawn from Tsutsumi Stamping Operations where automatic stamping machines have helped increase efficiency and productivity while reducing the number of workers on a line from the 1960 level of 14 to the current level of two or three. Although full automation is not yet completely implemented at Toyota, the plant represents major advances in automotive production technology. The white-collar sample was drawn from Stamping Engineering Number 1 of Body Production Engineering. This group designs, manufactures and maintains stamping dies for model changes. This group, too, had experienced changes brought on by the new technology. There, computer-aided design and standardisation have cut down the number of days needed for production and reduced manpower needs. In a number of ways the experiences of the two groups are very much alike.

Regarding multifunctionality, a large majority of the blue-collar workers polled wanted to learn a wider range of jobs. But almost half responded that they were not receiving training in new jobs. This, of course, does not contradict the principle of multifunctionality; it does suggest, however, that workers' expectations or desires in this regard are not being fully met.

As to team work: half expressed willingness to help each other; almost all of the rest wanted either to work separately or to have demarcated roles and help each other only when necessary. The other form of workplace group activity is the QC circle. Most workers were active; but a sizeable group was only reluctantly active if at all.

Participation in group activities outside the workplace is even lower: about two-thirds of the respondents seldom or never attend friendship group

meetings, and only a handful go very frequently. Workers are more likely to participate in union activities, the majority attending shop meetings usually or always. Nevertheless, although largely unwilling to join in company-sponsored activities, a large minority of respondents were "obsessed" with an awareness of their "duty of work" even during leisure time. Participation in the "suggestion systems" is another measure of involvement or dedication: over half participate above the preset goal, the remainder participate reluctantly or not at all. So it seems that a degree of dedication to work has been developed among Toyota workers, though perhaps not as strongly as management would like.

The white-collar group, Stamping Staff 1, has formed a special type of group activity called the AD (Ability Development) circle. Unique to Stamping Staff 1, these groups evolved from voluntary, independently organised study groups. Now they are an important part of the work organisation of Stamping Staff 1, and have a high rate of participation. Each year each group studies two or three topics relating to technological problems in daily work, quality improvement, or analysis of technological improvements. A major purpose of the AD circle is to exchange information horizontally, although research results are also sent to managers and general managers several times each year. AD circles are also seen as a means through which employees can develop their skills and capacities. In general, AD circles have been quite successful -- they have helped reduce the number of man-hours necessary to prepare for ordinary production and, each year, the number of suggestions per group rises.

Briefly, the survey of engineers indicates that they generally hold positive attitudes towards the present form of work organisation. They prefer OJT, study-groups, and self-tutoring to outside training and appreciate AD circles as important vehicles to learn new skills and their application, as well as to learn to work with colleagues. Yet there remains some uncertainty about the new technology: about one-third feel that they cannot follow the technological changes.

In terms of job involvement, most are quite active in study groups and almost all are interested in learning a wider variety of tasks. Once off the job, however, most do not think much about it. Furthermore, engineers seldom participate in company friendship clubs, though university graduates do tend to join company-based alumni associations. In general, both blue- and white-collar workers seem to adhere to similar attitudes and patterns of behaviour.

Toyota management has introduced new technology in order to make efficient multi-item, small lot production of high quality cars. In support of this aim, management has made efforts to broaden and deepen the system of continuous education to produce more flexible workers, to integrate workers of varied social backgrounds, and to create an enthusiastic and involved workforce. Co-operation between all segments of the firm -- white- and blue-collar, union and management -- and the sharing of common goals form the underpinnings of the corporate culture and organisation.

c) Human Resource Development at Volkswagen and at the Hanover plant

As do all German industrial firms, Volkswagen operates within the fairly strict confines of legal rulings on work conditions, work organisation, and professional qualifications. Within the context of these regulations Volkswagen has sought to implement innovations in technology in order to maintain a leading position in the world automobile market. The stipulations of the regulations as well as the need of the new technology have jointly shaped corporate policies on work organisation and training throughout the Company.

An important part of the implementation and planning process is the co-operation with the Works Council. Regarding personnel issues and training, the Works Council shares planning, decision-making and implementation power with management. It has shown an active interest in participating -- setting up its own training and education committees, for example -- and co-operating with management at all levels.

In the ongoing process of technological change, Volkswagen has identified several guiding principles or objectives regarding the organisation of work. Central to these objectives is the humanisation of work, brought about in particular by job enrichment and enlargement. This has meant considerable changes on the shop floor, including the creation of new job categories. A second principle is the development of an employee-oriented work organisation. This sometimes takes the form of assembly work carried out by work teams, or may require the redesign of tools and attachments. The goal is to improve working conditions and workers' satisfaction while maintaining productivity increases. A third objective is to increase the workers' dedication to Volkswagen by increasing their level of involvement in the job and in the Company.

In order to realise these objectives, Volkswagen has introduced a number of concrete changes on the shop floor. One such change is the creation in several plants of broadly-defined job classifications. To fulfill the requirements of these jobs, workers must acquire knowledge of a variety of tasks. This new role usually demands a higher order of skills from the worker since often he must not only know how to operate several machines, but also how to maintain them and how to diagnose problems. For his part, the worker gains a measure of autonomy, variety of work as he moves around the line, more responsibility, and a concomitant rise in pay. His flexibility is also of great benefit to the Company -- not only is the worker more able to fit in where needed, he will presumably be more adaptable to future changes.

Breaking the typical pattern of "one man-one machine" with the introduction of multifunctional workers, the next step was the establishment of "work systems". A work system combines "like functions having similar elements and clear-cut sequence organisation". All workers within the system are paid the same wage and expected to have competence in all of its tasks. In this way, after negotiation with the trade unions, 28 wage groups were reduced to twelve. This new wage structure, the establishment of work systems, and broadened requirement profiles for workers are the primary changes in work organisation within Volkswagen.

The restructured organisation of work is part of a trend towards decentralisation and the transferral of authority and competence. More and more decisions are being made at lower levels within the Corporation, in part to make jobs more attractive, to increase workers' initiative, improve quality, and increase the level of workers' involvement in the job and the Company. The Company recognises the social, emotional, and intellectual sides of the worker and, through restructured work patterns and training programmes, aims to fully integrate the worker into the corporate culture.

Such changes could not have been implemented without training programmes geared toward fitting the worker into the new scheme. Management views training and education as a basic and essential investment to insure the Company's competitiveness in the long run. Three types of training are distinguished: initial professional training (i.e. apprenticeship training), continuing technical training, and continuing further training. The first type, which is an apprenticeship scheme for high school leavers lasting commonly three years and combining training in the enterprise and vocational education in schools, is closely regulated by the State. Continuing technical training, which largely prepares the worker for his specific job, is left to the Company. This phase of training is designed to meet its specific needs, so it is therefore here that the worker receives training in the new technology. Continuing general training is mainly targeted towards middle management. Its purpose is to improve co-operative and managerial conduct. In addition to these programmes, workers are able to pursue other educational opportunities thanks to the legally-sanctioned educational leave system in the Land of Lower Saxony which gives every worker and employee a two-week entitlement for vocational, civic, or general education courses outside the company. Thus, although company-sponsored training is "practice-oriented" and stresses the functional requirements of the job, workers do have an opportunity for personal development through education.

The actual shop-floor implementation of these principles and programmes varies according to the needs of the plant. The Hanover assembly plant provides an example of how changes have been translated into practice and the impact they have had on work roles and relationships as well as on training and education programmes.

Robotised in 1979-1980, the Volkswagen Hanover plant has been the largest user of industrial robots in the Volkswagen Corporation. Here, management has created the new job description of Transfer Line Controller in the plant's body shop. This is a semi-skilled occupation with broadly-defined work responsibilities. His primary tasks are in monitoring and maintaining the system. Furthermore, his work area is the whole line, not just one machine. Because the line has been heavily automated, the Transfer Line Controller has become an overseer of operations rather than a direct participant.

In the robotised units two types of tasks have prevailed: low-skilled, auxiliary tasks such as feeding parts into the system, and high-skill co-ordination and control functions. In fact, a gap is growing between the strata of workers: "the present situation in the body shop is marked by a pronounced polarisation of qualification structures". This is not necessarily due solely to technological change, but is dependent upon "an inherent socio-organisational pattern of division of labour" in which tasks are

distributed according to traditional patterns of jurisdiction. This suggests that the new technology has not created a new situation, but exacerbated an old one.

The supervisor's role has also changed under rationalisation. For example, he now has been assigned to more work areas because the new work groups are small (10 to 20 workers) and management wished to maintain the supervisor-worker ratio of about 1 to 88. Another change triggered by automation was the relationship between supervisor and workers. His control over semi-skilled and skilled workers has been reduced; on the other hand, automation has augmented his organisational and co-ordination functions, especially in maintenance.

Despite the many changes effected by the rationalisation process, the relationship between function, qualification and wage remains fast. So, too, does the link between age and seniority: the workforce is ageing collectively even in the face of rationalisation and transfers of personnel. It is also interesting to note that robotisation did not significantly alter the percentage of vocationally-trained personnel in the automated areas, as had been expected. So the new technology has had an impact on some areas of work while leaving others unchanged.

When management initiated the change process, training and qualification needs received very little consideration. Even at the time the workforce was selected for the area, qualification levels were not a major factor. Instead, training was supplied later. In two respects -- organisational and individual -- a worker's function strongly influences who will receive training: those with some training (in other words, those in semi-skilled or skilled jobs) are selected for continuing training; in addition, those with higher qualifications tend to have more interest in increasing their qualifications. On the whole, however, actual participation in training depends on the functional requirements of the job and not much on personal characteristics and interests. Management does not encourage individual efforts to be trained for fear that it will mean higher wage demands and the hampering of personnel reductions and transfers. In the case of the Hanover plant only maintenance personnel and transfer line controllers received training, and, except for a few maintenance people trained outside the Company, training was provided in-house. Lower-skilled workers received almost no training at all.

Content of training was both practical and abstract. Transfer Line Controllors, for example, received extensive training in pneumatics, hydraulics, and electrotechnics. In addition to this, however, they also received "training for diagnosis" -- essentially training in logical thought. Furthermore, there is some discussion about training transfer line controllers to perform more maintenance tasks. This would be in line with policies on job enrichment for these semi-skilled workers.

As part of the evaluation of the relationship between technological change and human resource development, the researchers asked workers at Hanover to assess the impact of new technology on their work lives. Four general issue areas were identified: qualifications, social integration, basic interests, and concern for the future. As had to be expected, the answers from workers depended not only on their being directly affected by

technological change but also by seniority, occupational status, and by working conditions and social relations prevailing in the plant or unit concerned.

Regarding qualifications in general, skilled or semi-skilled workers stressed the importance of technical-functional knowledge and capabilities for successful accomplishment of tasks. Workers with lower skills, however, stressed instead the importance of work ethics for actual work performance. According to the research report, it seems that work ethics appear to be a "compensatory element of qualification consciousness in the absence of training". The capacity to endure psycho-physical stress was deemed necessary only in a situational context, especially in automated production.

Social integration is not high for individual workers -- only 19 per cent felt their opinions were respected. A larger number (52 per cent), however, felt that management respected the opinion of the Works Council. This may be due in part to the Council's increased active involvement since 1979 in decision-making, especially in decisions regarding work organisation. Prior to this, management informed the Council of changes under consideration, but the Council itself was rarely actively involved.

Interpersonal relations are another aspect of social integration. When in need of help, both personal and professional, many workers turn to superiors. When facing personal problems, however, lower qualified workers tend to go to works councillors. Maintenance workers are the exception in both cases: they always prefer to consult their colleagues.

The researchers identified three basic interests of workers: to optimise the utilisation of their manpower, to protect it, and to gain autonomy and influence. In general, the higher up the skill ladder, the more positive the attitudes. Those facing change and those in conventional production -- largely unskilled -- are the most problem-conscious and most likely to feel that technology will not further their basic interests. Almost all of those facing automation foresee a change for the worse, although those already in automated areas feel more autonomous and, in general, have a more positive attitude.

Finally, with regard to the future, most workers feel insecure in their jobs and, consequently, a large majority of them are interested in receiving more training. They place conditions on that training, however. For example, they would prefer training during work hours and would not want it to involve a job transfer.

Volkswagen's strategy for change has emphasized the humanisation of work by providing the worker with a more active role in the job. The new worker supervises the work process rather than acting as a simple mechanical extension of the machine. By giving workers an active role, the Company has also increased its own creative resources. Although workers are not yet completely comfortable with the new work style, these changes appear to be the pattern for the future and seem to have contributed positively to work conditions, labour relations, productivity and product quality.

d) Human Resource Development at Régie Renault and the Le Mans Plant

According to the Renault company report, the Company's assumption regarding its human resource management programmes has been that "the introduction of new technologies can provide a privileged opportunity simultaneously to upgrade the company's competitive position and employees' working conditions". The basic principles of human resource development at Renault are to promote better management/employee communications, enhance co-operation, and encourage worker participation in the introduction and implementation of new technology. These principles are realised through a variety of new forms of work organisation and training.

Renault operates within the legally-prescribed framework of training, which requires the works council's approval on training plans and sets a minimum training budget relative to payroll. At the same time, Renault has been a pace-setter for company-level industrial relations in France. The Company has adopted and relied upon a "contractual policy", which means negotiated solutions in many cases of technological change. The active participation of personnel has been reinforced through the creation of study groups, "expression groups", and quality circles which had been developed even before the 1982 legislation concerning increased workers' participation.

Mainly due to the pressing need to enhance working conditions and to meet employees' expectations, there has been a shift away from conventional "scientific work organisation" models such as Taylorism. New forms of work organisation include work teams, job rotation, and polyvalent workers. These forms combine so that, within a small assembly unit, or "module", multi-skilled workers may rotate between work stations. It has been observed that as technology changes, there occurs a shift from the "one man-one machine" organisation concept, to the concept of "one group-one system" where the first objective is to achieve a complementarity among the members of the group, to increase the importance of intellectual tasks to reduce conventional boundaries between production and maintenance. This implies job enrichment for the individual worker and necessitates higher qualification levels for the employee since he is now handling technically sophisticated equipment and has broader responsibilities for the machinery and its output.

The role of the supervisor has changed as well. In addition to the traditional tasks of leading and supervising employees, the new supervisor must be accustomed to managing sophisticated technical systems. Moreover, supervisors are expected to train their subordinates in the use of this equipment. In this way training has become an important element of industrial relations on the shop floor.

While training programmes were always considered to be generally career-oriented, the Company agreement of December 1981 established that there was to be a direct and concrete link between the training of production workers and their careers. They are designed to help employees pursue highly skilled jobs. According to the company report: "Improving the Company's overall performance depends on achieving a set of technical, economic and industrial relations objectives extending beyond ensuring that certain target groups master the consequences of technological change. Rather, this set of objectives requires the career and personal development of each man and woman

in the Company". As a result, the Company spends one-fifth of the total training budget for career-advancement programmes for AP and P1 (lower level) production workers.

Another strategic aspect of company policy can be observed in the decentralisation of its training functions. More on-the-job instructors have been recruited in each plant. In addition, long-term training programmes for workers are designed and implemented through discussions among managers and between management and union at the plant level.

As the technology advances, more abstract knowledge, skill, and understanding will be needed in addition to the general and basic knowledge of French, mathematics and logic. At the company level, the Advanced Technological Training Service helps workers catch up with the highly abstract notions of advanced technology. This service, however, is not intended to stand alone. Training is not reserved for use by specialists, but is the responsibility of every manager in the Company.

Many of these changes were inaugurated as part of the corporate decision to introduce new forms of technology in the 1970s. The Renault plant at Le Mans was one of the plants where significant changes took place as a result of automation. Prior to the automation of the X42 stub axle carrier, production work consisted of simple, repetitive operations which required little training. The few skilled jobs were in inspection and finishing. Today, the primary tasks are highly skilled maintenance and tooling jobs. Although economic factors such as increasing foreign competition and recessions were probably most important in stimulating change, the push from within the company by lower-level workers for new forms of work organisation were undoubtedly also a strong influence.

In the late 1960s and early 1970s industrial disputes at Le Mans were led by semi-skilled workers rejecting fragmented and repetitive work. As a result of this, a "module assembly system" for front and rear axles was established. This new system meant that assembly was done in work teams of three to five self-organising, multifunctional workers responsible for their own output (quality, etc.). Again, in 1975, a long strike brought up the issue of working conditions. All in all, under these pressures, efforts have been made for over a decade to enrich work by reducing the monotony and increasing the range of tasks and level of responsibility available to workers.

The new technology has changed the definition of the operator's duties. While the visiting research group found that operators have actually lost a degree of autonomy but gained greater competence in technical skills, the Company maintains that, on the contrary, operators have seen an enlargement of their tasks by means of work in teams and job rotation within these teams. Technically, there is no manual operation of equipment, only "temporary manual control" in order to return the machine to automatic. Nevertheless, because setting adjustments and stoppages occur more often than had been expected, the operator needs to learn how to handle them. During this study it was observed that standard procedures took care of most stoppages -- about two-thirds of them were short (less than five minutes) and, therefore, fell within the jurisdiction of the operators. To speed up the return to production, operators also do some repairs they are technically not supposed to do. These they learn by watching maintenance.

Despite automation, which has generally reduced workers' submission to machine rhythms, there are still some fragmented tasks which are set to the pace of the machine. In fact, the number of jobs tied to the machine is higher than had been expected: just over half of the workers have jobs which are presently still linked to the machine cycle. Yet, because of the higher skill level, greater responsibilities and some job rotation, workers see automation as enriching their work and providing autonomy.

Most of the workers in the automated area are CCUAs or soon will be. The CCUA (conducteur confirmé d'unités automatisées, or skilled automated unit attendant) is someone who has received considerable training, who can function either independently or in a team, and who can perform all the operations "leading to the achievement of given qualitative and quantitative norms". Created in 1980, this category was intended to meet the needs of the new automation and respond to its problems, to improve working conditions and enrich job content and formally to recognise workers' potential.

Although the primary purpose of the CCUA was to meet the needs of the new technology, in which work is continuous, it also improved the actual jobs themselves. Workers are polyvalent so they are able to rotate jobs, sometimes on a daily basis, in order to have variety in their work. Jobs have been further enriched by allowing operators to perform a few maintenance tasks and their own tool changes, as well as assisting production management supervisors to a small degree. Its creation also provides a category into which lower-level workers may be promoted in recognition of their potential and as an opportunity for career development among blue-collar employees.

New technology has also had an impact on maintenance work. In terms of the workforce, it has created a need for more electricians for the new automated units. It has also forced maintenance to share its responsibilities with production. This is not an entirely new development, but now maintenance workers are taught to work within the new system. This has been criticised as a possible source of "demotivation" for maintenance workers who have now to share part of their responsibility with system operators.

The introduction of new technology and the change in the structure of work organisation has been an interactive process. To a certain extent the changes have been autonomous but reinforcing. In fact, the researchers remark that "it might even be fair to say that automation is seized as an opportunity for pursuing human resource objectives not directly related to automation". In other words, changes in the way work is done are not necessarily solely or even primarily due to changes in technology, but may be introduced on their own merits.

Training facilitates this process by adapting workers in their new work system to the new technology. Training to become a CCUA takes six months, including three months of general training. The course includes basic background training (e.g. mathematics), theoretical training in electricity among other topics, and practical training on the shop floor. Not only has the training for machine operators become more complex, it seems to have taken on more importance by its introduction at an early phase of the change process.

As well as leading workers to a familiarity with the new machinery, training of CCUAs serves another purpose: it qualifies them for promotion to

a higher grade. The training also helps to identify and select workers with high potential and provides them with the necessary "industrial culture". It both prepares them for work and socialises them into a new cultural environment.

Attitudes towards the training are mixed. Some of those interviewed for this study feel the training is good even if only in developing in workers some measure of familiarity with the machines. Some are critical of the course, complaining that it is not relevant to the actual tasks. The informal on-the-job training seems to be the most important aspect of training to workers. OJT also gives the workers a sense of responsibility for the quality of production.

Workers did have a chance for "hands-on" training away from the vocational training centre early in the process of implementation of the new equipment. Even prior to the installation, the plant sent representatives from all sections involved to the vendors to study, observe, and make suggestions regarding the new equipment. Once installed, introduction to the new equipment was made first to maintenance workers, perhaps because they were better prepared for the training and because they were considered most important for future efficient operations. Although production staff became involved in principle only when the plant was ready for normal output, during the earlier phase they were able to watch and ask questions about the new machines and their operations. This essential training, however, was not organised or encouraged -- largely because it was just not part of the normal practice. Nevertheless, this experience meant that people were ready to work even before training was officially scheduled. At this early stage they were able to learn the basic skills, later passing them on to new staff as they entered.

The trend at Renault has been to give workers more information about the jobs as well as creating in them more awareness about management activities. Training has allowed them to take on more responsibilities. However, it is probably fair to say that, until recently, training has been geared more towards the specific requirements of the job, rather than to career development. But, as already mentioned, in recent years both the Company and the unions have become aware of the necessities of career development of both blue- and white-collar employees -- the CCUA is one example of this response. This is part of management's growing interest in developing human resources.

In their report, the research group emphasize that technological change is a complex process which influences and is influenced by many elements in the corporate environment. For example, structure of the workforce, number of immigrants, phase of the production process, and other plant characteristics strongly influence the reception of new technology, the efficacy of training, the involvement and interest of the workers, etc. In order to be effective, new technology requires change in both organisation and attitudes and a greater understanding of the complex new environment.

e) Human Resource Development at Volvo Car Corporation and at the Olofström Plant

The first efforts to restructure work organisation within the Volvo group were mainly developed at plant level. The different phases can be identified with one special workplace at a time but overlapping has occurred between the plants. Thus in the mid-1960s a number of different initiatives were taken in various parts of the company. Many of these efforts were attempts to reduce worker alienation and improve working conditions mostly in the lowest level in the organisation. The early 1970s saw the inauguration of a new phase of corporate-level drives to increase profitability and financial strength through technological and ergonomic development. The overall objective, according to the company, is "to create effective and competitive production systems which, at the same time, comprise attractive workplaces". The planning of the Kalmar plant was the turning point. The executive management required an entirely new outlook, with a completely new concept. The way of achieving it was to bring together all of the experience that had been gained at the various plants. Since 1971/72 a number of new projects have been started that are based on earlier experience and on the active and expressed support of top management. This second phase thus involved the instutionalisation of change.

Achievement of this objective required, of course, investment in new technology. It was also recognised, however, that "human beings make up the most important company resource"; therefore, further investment needed to be made in human resources as well. In a broad sense this was meant to include not only the development of new training programmes, but also the creation of meaningful and satisfying jobs.

Volvo recognised that the twin aims to increase efficiency and enhance the quality of working life required changes at all levels within the company. Some of these changes, such as the legislation providing the representation of labour on the board of directors, were initiated outside of the company. Other changes -- such as those in work organisation, relationships, and roles -- came about through negotiated agreements between labour and management. In addition to structural changes, management style has changed; the Company states that "management must be based on clear values and objectives, open communication, respect, trust, solidarity and initiative". The focus of change has not been one-sided or narrow, but broad-sweeping in its impact throughout the organisation.

According to the Company, co-operation and participation are two key elements of the change and of the process by which it is developed. Within Volvo, co-operative efforts have grown in the past few years such that employee representatives have participated in all recent strategic decisions. This co-operation extends all the way down to the shop floor.

Increasing worker competence is one way to practise these principles of co-operation and participation. With greater competence, the workers' level of influence, responsibility and involvement may increase. In other words, workers are more capable of making decisions and solving problems in the context of their greater understanding of the work process and of the business environment of the Company.

In addition to creating a more knowledgeable workforce, Volvo has, in many places, reorganised individual workers into "natural working teams". These units may then be used as independent units of accounting or production. At the Kalmar plant, for example, two or three teams make up a profit area under one supervisor; and each area has its own quality, quantity, and personnel targets. One reason for the establishment of independent groups is to make clear the demands placed on it. Furthermore, it facilitates job rotation: team members are responsible for all of the tasks assigned to the team and are able to function in a range of jobs.

To adapt the workforce to the new technology and to the new work organisation, a company must provide training. Training in Volvo is highly decentralised and is largely used as a strategic instrument in organisational development. Resources for training are allocated to the lower levels of management within the framework of the ordinary budget. Planning and implementation of training is then largely left up to plant level management personnel. In the Torslanda plant, for example, management and labour union representatives jointly formed a special training and development committee. This committee deals with matters related to organisation and personnel development and carries out training with the objective of organisational development. But it should be noted that Volvo relies much more on changes in the work organisation than training efforts to achieve its goals. The work organisation has the double role of being an instrument for change as well as an important instrument for utilisation and development of human resources.

There is a trend towards increased reliance upon internally developed training that focuses on promoting workers' understanding of their work environment and related tasks. In addition to the sessions on quality, materials and maintenance, the training includes topics on work organisation and other social aspects of the Company.

A more concrete example of the changes that have been instituted and their impact is given in the research report, which focuses on the transition process that had been ongoing since 1970. Changes were initiated on the presslines at the site selected, Volvo Olofströmsverken (VOV), in 1970. These changes were both technological and organisational and they have been quite extensive: in the early 1970s operations were completely manual, now they are almost entirely automated. Because of this long, slow process of change, VOV has had a long tradition of human relations development activities in the context of technological change.

In the late 1960s VOV did not have a highly-motivated shop-floor staff. The plant had high turnover and absentee rates and difficulty in recruiting new personnel. In addition, there was very low involvement of the workers in the work process. Management attributed this to the unvaried work at a machine-set pace for a very brief (six to ten seconds) work cycle. Workers could not leave their machines and this tedium was interfering with efficiency. So, in co-operation with the union, management launched a project to improve work conditions and increase recruitment and retention rates.

The goal of the project was to give the worker more variety in his work, more flexibility in terms of his workplace, and a sense of being a member of an operational group while, of course, maintaining productivity increases. Increasing the degree of freedom available to workers

automatically facilitated the creation of self-regulating production groups. Freeing them from the line meant automation. The primary changes were not in the presses themselves, but in the handling equipment. This mechanisation reduced the need for personnel and eliminated the more arduous and hazardous tasks. It also made the press line a more integrated unit. This lent itself quite effectively to group-oriented rather than individual-oriented work.

The implementation of this new technology led to other changes as well. The operators' relatively low skill level made evident a need for new training programmes. Because training was seen as a necessary instrument for change, VOV has developed a strong, active, and involved training department, yet one which remains flexible enough to work with other units, such as production. Training and development activities were very high during the 1970s, yet the research team says it found little direct relationship between formal training and the introduction of new technology. The training activities and the new technology were from time to time parallel processes and in the long run influenced each other. It should also be noted that training and development of the employees are the direct responsibility of the line managers.

The objective of this training was to provide employees with an understanding of the functions of the different types of equipment, and develop their ability to adjust press tools and mechanised equipment. The provision for a press operator prior to the job enlargement project was a two- to three-day course on press technique which complemented one week's training in die shifts and one week's training in mechanisation. The new jobs required a four-months' training period for an operator on a fully automated press line. About one-fifth of the training is theoretical and includes instruction in materials, measuring techniques, pneumatics, quality control and safety rules. This training helped operators attain a different and higher level of skills than they had previously developed.

As well as this programme for press operators, other types of training provided by the Company included production group development activities, external training courses, and management training and development activities. In addition, workers themselves often took the initiative to request or develop training opportunities. In general, training was an integral part of the change process, not a supplement: according to the research team, "the integration of technology with organisation and training is a characteristic of the company culture".

It was not only blue-collar workers who needed retraining, but supervisory staff as well. As groups matured and gradually became self-managing, the supervisor's role became more ambiguous. The role of the "time-study people", production engineers, too, became unclear. Through special development programmes these supervisory groups were reorganised and reoriented. The supervisors' training programme, for example, stressed the support role supervisors should play for the production groups: the "future main task of a supervisor was to 'utilise' the resources of the group in a way that the need of the individual was met". The goal was to integrate management into the changing work organisation. Not only the role but the relationships between workers and supervisors has changed, and researchers have noted that this "vertical restructuring" has resulted in a "flatter" hierarchy.

A third outcome of the initial changes has been a new wage system. Workers in a group had acquired new sets of skills through job rotation and training, and based a demand for higher wages on their new skill levels. The current wage system accounts for this while also encouraging team work: wages are based on an hourly rate, skill level, and group performance. When first changed, workers redistributed quality adjustment work among themselves, greatly reducing rates of adjustment. This change in the wage system mirrored the change in work organisation.

In a sense, the structure of work organisation has come full circle since the establishment of VOV. In the early 1950s a group of three to five employees worked a press; work was heavy and difficult, but characterised by craftsmanship. Morale was high during this period. From the mid-1950s to the early 1970s work was heavily specialised and work teams were reorganised after each press cycle. Sometimes the cycle was only two or three days long and workers had no chance to develop a group sense or to make friends. The next stage came in the mid-70s when press lines were mechanised. During that time eight or nine people worked a line in teams, which allowed more freedom and job rotation. Most recently, since the late 1970s, stable, self-regulating, multi-skilled groups of about five have come to be the unit of production. And interviews reveal high morale, team sprit, and good working relations in these teams.

Workers today have a much broader range of responsibilities than before the changes were initiated in 1970. They now control, supervise and adjust the production process and perform qualified control and maintenance tasks. Five job categories of the early 1960s have been rolled into one to create this new operator. No longer is there a trend towards specialisation and no longer are workers simple extensions of their machines. Instead, their teams represent the unit of production for which all other units, including engineers, are to provide support.

The results of these changes have not been greatly dramatic. In 1977 absenteeism and turnover were down while productivity rose, but there was also a recession during that period which severely checked the mobility of the workforce. The results are viewed as a success, however, because there has been some improvement in these statistical measures and, in addition, job satisfaction seems to be way up over the earlier period. Some of the experiences in Olofström have been of significant importance for the development in other parts of the Volvo group as well, the objective in mind being to "develop production technology and work organisation toward two ends: craftsmanship and automation".

There are several reasons for this success: union-management co-operation, stable management, slow progress, a positive social climate, and supportive legislation. From the beginning, management and unions worked together to create a new work environment. Many of those managers involved at the outset stayed at VOV and continued to push for change. The key pressure group, however, seems to have consisted of a number of younger managers and external and internal consultants at the lower level of the management hierarchy. Stimulated by the overall "climate" for participative structures and work, i.e. design, they formed an informal, ideologically based network. It is evident that the work of this group had a big impact on the design and

performance of the experiments. Another important fact was the "tacit support" from the top management. The data obtained show that, although top management was never directly involved in the actual design of the experiments prior to 1979/80, it did, however, support the various activities inside VOV and actively promoted the VOV "model" within corporate headquarters.

External factors also contributed to the success of changes at VOV. For example, work democracy was being discussed and tried throughout major Scandinavian industries. Furthermore, two laws had been passed in Sweden which had a positive influence on attitudes towards training: one made it possible for employees to get study leave; the other guaranteed government funds for companies that trained rather than laid off workers. So, both internal and external conditions were largely supportive of the changes taking place at VOV.

With the aim of increasing efficiency and at the same time improving the quality of working life, Volvo has sought "to unite in one and the same solution elements that are conventionally regarded as contradictory, that is, to implement a number of simple measures that involve integration of hardware and software". In other words, Volvo management views success as the result of equally integrating both technical and social aspects of the production process.

III. TECHNOLOGICAL CHANGE AND ITS MANAGEMENT IN THE AUTOMOBILE INDUSTRY (3)

The content of this chapter is mostly derived from the ten Part III reports of the CERI project; for the rest we have drawn on a few "outside" but relevant studies that have been made of the industry. Central to its understanding is that: while the automobile industry is the prime source of its own product technology, it is mainly a user -- not the originator --of the automation technology embodied in its manufacturing equipment and processes. Whereas technology planning and decision-making have traditionally followed a top-down managerial process, the trend is towards increasing employee participation at all levels. In fact, this change in managerial style (or "managerial technology") is judged to be a potentially higher contribution than the traditional technology to the improvement of product quality and manufacturing productivity of the industry. Thus, in the context of our study, technology is on an equal level with human resource development and utilisation (training and work organisation) -- all three being very important, but none being necessarily predominant instruments for managing change.

1. Technology in the Automobile Industry

In discussing technology in the automobile industry, it is useful to recognise three distinct types when looking at recent and future changes. These can be referred to briefly as "product", "equipment" and "process" technology.

Product Technology

Product technology is embodied in the product itself, that is, the automobile produced by the automobile industry. In the eighty-year history of the industry, product technology settled into the internal combustion engine with, until a decade ago, major technology innovations concentrated on the V-8 engine. The major forces pushing for product technological changes were, primarily, customer demand and then government regulations. The innovations initiated within the companies had emphasized styling, comfort, reliability and performance; the government regulations played an increasing role in safety, emissions and fuel economy. Since the energy crisis of 1973, fuel economy, pushed by both customer demand and government regulations, became a primary force behind product-oriented technological innovation. This manifested itself in automobile down-sizing, use of light materials, and engine efficiency (4).

Down-sizing is usually accompanied by downgrading of comfort and performance of the automobile. Thus, the recent oil glut, resulting in at least a temporary reduction in gasoline prices, has dampened the customer demand for smaller cars (5). However, the technologies for lighter materials and higher engine efficiencies, once achieved, will stay; and the trend is clear for decreasing use of steel and glass, and increasing use of aluminium (cast and wrought) and plastics (non-reinforced, fibre-reinforced, and metal laminate). The shift towards smaller engines, with fewer cylinders (for the same size of vehicles) is also clear. Technologically, turbo-charged and super-charged engines are increasingly used to extend engine displacement and power. Diesel engine use is expected to grow in passenger cars to some extent as well as in trucks and vans. Front-wheel drive and five-speed manual transmission are also important product technology trends. Integrated body frame (unibody design), is expected to have growing use.

Perhaps the most important change in automobile product technology that is often hidden from the average customer is the use of new electronic components (micro-processors, actuators and transducers) in the controls for engine, drive train and brakes. On the other hand, the younger and more sophisticated customers are very aware of, and are creating an increasing demand for, electronics for driver assistance, instrumentation, as well as entertainment systems in the automobile -- thus putting further emphasis on electronics in automobile product technology.

Equipment Technology

Both equipment and process technologies are used in automotive manufacturing. We make a distinction between the two to emphasize the system aspect of process technology, as distinguished from technology embodied in a piece of equipment that may stand alone or operate in concert with other equipment in a manufacturing process. Thus, the moving assembly line introduced by Henry Ford in 1914 was a classical example of process technology, and the numerical control of machine tools is a more recent innovation in equipment technology.

The overview of the multi-stage process in Figure 1 is representative of all automotive manufacturing around the world (6). The basic equipment technology at each stage of the process varies more within a country (between

older and modern plants) than between countries. The first two stages in Figure 1 are often within the automotive supplier industry as well as the automobile industry itself, depending on the degree of vertical integration in the individual automobile companies. Thus, raw material processing draws on the technologies of steel, glass, rubber and petrochemical industries. The fabrication of raw materials into parts and components draws on the technologies of malleable and grey iron casting, plastic moulding and soft goods fabric weaving, to cite a few.

Four stages in Figure 1 are definitely within the automobile companies themselves. These four stages are engine fabrication and assembly, transmission fabrication and assembly, body component stamping and fabrication, and vehicle assembly and test. It is interesting to note that the five case studies under the present project are within the domain of the first three of these four stages:

Figure 1

Case Studies	Manufacturing Stages
Ford (crankshaft)	Engine fabrication and assembly
Renault (stub axle carrier)	Transmission fabrication and assembly
Toyota (stamping)	Body component stamping and fabrication
Volvo (stamping)	
Volkswagen (body shell assembly)	Vehicle assembly and test

It was no accident that the final vehicle assembly and testing was omitted in the case studies, for these concentrated on the impact of automation. The final assembly plant puts together a mix of body styles with options such as engine size, manual versus automatic transmission, front or rear wheel drive and left or right hand steering. In addition, each vehicle may have one of a large combination of optional accessories such as air conditioning, tape deck, wheel covers, upholstery, seat types. Because of this variety and complexity of the product itself, the final vehicle assembly and test stage is labour intensive and not amenable to a large degree of automation in the foreseeable future. However, this is not to say that equipment technology has remained stagnant in final vehicle assembly. Certainly, line equipment has been developed to relieve the physical workload and stress. For example, various steps to improve working posture have been introduced, including conveyors that change height and tilt conveyors which make overhead work more comfortable. Semi-automated processing has also been advanced in areas which involve working with heavy parts. Tyre-wheel assembly machines are one example of these improvements.

From the standpoint of automation technology, major penetration has been in the body component stamping and fabrication stage. Perhaps the most

dramatic and popular examples are the spray painting and spot welding robots in this stage of manufacturing. Most, if not all, the human operators have been replaced by dip tanks, and laser- or robot-controlled spray operations. As a result, the paint finishes are far more corrosion-resistant as well as looking better. In body assembly, manually-operated spot welding guns have been replaced with robotic spot welding and automated clamping fixtures for achieving reliable fit of body parts prior to welding. Up to 95 per cent of spot welds are performed by robots in the modern assembly plant (7).

The case studies of Toyota, Volvo and Volkswagen provide additional examples of automation in this stage of body component stamping and fabrication. Arc-welding robots are mentioned in the Toyota company report and CO2-welding robots are used along with spot-welding robots in the body shell shop of Volkswagen's Hanover Plant, which is the first large robot user among all Volkswagen plants. Incidentally, industrial robots are only a small incident in the long trend towards industrial automation since the end of World War II; for some reason, though, it is they that have caught the imagination of the public. The use of feedback control, and more recently computer control, of production equipment, signifies a more basic advance in automation technology. Examples of progress in this main stream of automation include advances in the body stamping shop from the manual-fed, to semi-automatic, and to fully automatic lines at Toyota, and from individual presses to micro-processor-controlled integration of the whole press lines using the Doppin feeders at Volvo.

Further manufacturing innovations have focused on body component stamping and fabrication because of the recent emphasis on flexible manufacturing and the number of different body panels, floors and roofs multiples with the increasing number of car models and variations (e.g. the number of Toyota models increased from nine in 1976 to eighteen in 1982). The strive for "economy of flexibility" has been the driving force behind the reduction of on-line die change time at the press lines from many hours to, in some cases, less than ten minutes ("single digit"). By contrast, the pressure for flexible manufacturing has not been as great in the stages of engine fabrication and assembly, and transmission fabrication and assembly, since the same engine or drive train may be shared by more than one model, and by several variations in the same model. Nevertheless, automation technology has also made great progress in engine manufacturing and in transmission manufacturing. The new equipment technology has been in the form of automatic transfer lines, programmable controllers, automatic gauging, dedicated robots (which perform more fixed routines than flexible robots), etc. Control computers are used to record production rates, down time, scrap counts, and the computer records make the defects and warranty repairs traceable to work stations responsible for the faulty production. The increasing emphasis on flexible manufacturing is expected to lead to additional major changes in equipment technologies for engine and transmission assembly and fabrication in the near future. Examples include: robotic, automatic guided vehicle systems (AGVS) for loading crankshaft castings at the beginning of the crankshaft lines, flexible machining to allow production of different cranks on the same line and same shift, etc.

Process Technology

As stated previously, process technology, as distinguished from equipment technology, stresses the system aspect of manufacturing. The manufacturing system includes both workers and machines, and process technology will have to include both in its development and implementation. Following the introduction of the moving assembly line, emphasis on process technology in the automobile industry continued with the application of Frederick Taylor's method of organising production. Taylor, the early twentieth century apostle of "scientific management", thought of the worker as a "multiple-purpose" tool -- whose work could be compartmentalised into narrow functions ... to be performed with little variation. The worker, in this context, was seldom encouraged to consider better ways to do the job.

In recent years, major innovations in automobile process technology have been advanced by the Japanese. The two basic concepts are the "just-in-time" production process, and the human-like automation [in Japanese "ninben jidoka", which has also been translated as "automation: (8)]. Although the first concept was introduced in the 1940s in several countries, including Japan, the extensive and successful practice in Japan of the just-in-time production, including the organisation of the automobile suppliers into a tightly scheduled process, has caught the attention of the whole world. Just-in-time refers to a concept for producing "exactly what is needed, when it is needed, in no more than the needed quantity". To put this concept into effect, Toyota has adopted a system where subsequent processes pick up from preceding processes only what they need when they need it. The preceding processes then produce only enough to replenish what was taken away. This is called the "fill-up production system".

The just-in-time concept, as realised by the fill-up production system, has led to other innovations in process technology. For example, an uneconomically large inventory of parts and semi-finished products would have to build up at the preceding processes if they were required to respond promptly to large and uncertain fluctuations in demand by the subsequent processes. Consequently, Toyota has introduced "heijunka" (levelling or uniformity) of production by reducing lot sizes and assembling different models alternately on the same production line. This led to an interaction with equipment technology in terms of requiring a substantial reduction in equipment set-up time. Thus, for example, in the body stamping shop discussed previously, there were simultaneous reductions in lot sizes (from 5 000 to 500) and in set-up time (from 40-150 minutes to 5-15 minutes) during the period from 1970 to 1980.

The second Japanese innovation in process technology, "human-like automation", refers to automatic production systems that have human-like intelligence. Specifically, this refers to production systems that are able to stop automatically in abnormal conditions, such as when a machine breaks down or when defective items are produced. Since the production systems include workers as well as machines, workers are authorised to stop the production line in case of some abnormality. One result of this system is a new approach to quality control -- getting rid of defective parts while they are produced, and stopping the production system to make the correction, if necessary, rather than forwarding defective parts to subsequent processes and catching them by later inspection.

Human-like automation also implies a wiser use of the worker-machine production system. The concept strives for an optimum design of the system in which the worker, instead of being "compartmentalised into narrow functions" as in Taylor's scientific management, would contribute to total production through maximum use of his potential ability and maximum use of his time. Toyota gave an example in which, before improvements by human-like automation, three workers were needed to operate the three machines of stamping, conveying and spot-welding in tandem. Each machine required the attendance of a worker to maximise the throughput of that machine as well as checking the product quality. After the improvements by human-like automation, one worker operates the entire line in which small presses are located nearby, allowing the welding of one piece while the small presses slowly stamp other pieces. The result is a multi-process handling by a single worker, who has progressed from being a single-function worker to a multi-function worker. The potential of the worker is more fully utilised and the quality of his work life has also increased.

With the recent explosive development of computer-aided design and computer-aided manufacturing (CAD/CAM), and the automobile industry as the single most important user of this "high technology", another major change of process technology appears to be in the making for the automobile industry. At present, CAD has been used to aid automobile design only in a piecemeal fashion. For example, the output of a computer-aided drafting system is often not directly usable as an input to computer-aided engineering analysis (e.g. finite element analysis), since the former operates with a geometric model while the latter often operates with an analytical model. However, research is being conducted to link the two together. At present, CAM is most commonly represented by computer-controlled machine tools and intelligent robots. Their integration is in a flexible manufacturing cell, and the co-ordination of these cells by computer-aided production scheduling is being actively developed. Computer integration of CAD and CAM through a common data base, and the computer-aided implementation of designing parts to be more manufacturable, are all being put into actual practice. This advancement in computerised process technology will certainly affect the work function of both blue-collar and white-collar workers, the division between the two being increasingly blurred. In fact, one can foresee the linkage through computer systems not only between design and manufacturing but also with ties to purchasing, sales, service, and other broad functions within the automobile and its supplier industries.

2. Process of Technological Change

Technological change in the automobile industry is a dynamic but evolutionary process. This is true for all three types of technology -- "product", "equipment" and "process". A new technology emerges, develops through many trials and errors, and continues to change and advance rather than remain fixed between major renovations or expansions. In large automobile companies like the ones where the five case studies were conducted, one can use a model of a spiral to visualise the process of technological change: technology within a company ascends the spiral gradually, moving from plant to plant incrementally. However, viewed from the perspective of a single plant, change may seem revolutionary -- as in a jump from one level in the spiral to another. Thus, each of Ford's six North American engine plants

(Dearborn, Lima, Cleveland, Windsor, Essex and Chihuahua), and their counterparts elsewhere in the world, undergo some measure of technological updating every few years, and the latest renovation at any plant would include incremental technological advances beyond the previous successful changes at other plants. In Volkswagen, the robot applications in Hanover partly benefited from the robotisation at Wolfsburg. The incremental, trial-and-error approach in technological change, along with practical limits of financial and human resources, means that systems of quite different levels often coexist in the same plant.

While the general goals of introducing new technology are keyed to the broad corporate objectives, ranging from improved profitability to improved product quality, the emphasis on specific goals seems to be closely linked to corporate strategies. For example, Toyota emphasizes technology responding to product diversification and improved working environment, and Volvo stresses the dual objective of creating effective and competitive production systems which, at the same time, comprise attractive workplaces. Perhaps the principal determinant of technological innovation is typified by Ford's product planning process which goes through the following five phases:

1. Business Strategy Development;

2. Product Development Strategy;

3. Concept Development;

4. Advanced Programme Development;

5. Production Programme Execution.

Although not all the automobile companies use exactly the same process, they share certain key characteristics of technological change implied by Ford's product planning procedure.

First, the decision leading to technological change is largely market-driven and involves complex planning on an international scale. Thus, in a sense, product technology, as well as product needs, provides the criteria for choosing appropriate equipment and process technologies. For example, the basic force behind the renovation of Ford's Dearborn Engine Plant was the market shift from large cars to small cars in the United States. The "world car" concept, as well as limited resources, led Ford to seek a single basic engine design for its new generation of small cars. After the basic choice of the "Hemi" engine, further development and final design were carried out by Ford's engineers in Europe, as they were more experienced in designing small, fuel-efficient engines which had higher speed and torque than their American counterparts at that time. The new engine required much tighter tolerances (60 per cent tighter in crankshaft operations) which, along with the broader goals of improved productivity and working conditions, provided the criteria for determining the new manufacturing technology at the renovated Dearborn Engine Plant.

The influence of market characteristics on manufacturing technology can also be illustrated by the Toyota case. As Japanese society became more affluent at the beginning of the 1970s, customers demanded a greater diversity

of automobiles to suit their individual tastes. At the same time, the expansion of international market for Japanese cars meant that a greater variety of engines had to be produced to comply with various exhaust emission regulations in different regions. As a result, Toyota increased its number of models from nine to eighteen, and one of its models, Corolla, increased its variations from 21 to 65 over the twelve-year period from 1970 to 1982. This product diversification gave impetus to the development of the new process and equipment technologies, already described, that emphasize small lots and reduced set-up time. The need for more flexible manufacturing systems also attracts the development and application of robots and CAD/CAM technologies.

Another characteristic of the product planning process is that it involves many departments and plants in the company. In Ford's case, a number of advisory committees and the central staffs provide support for the Office of the Chief Executive in this process. In the case of the Hemi engine, the corporate product planning group decided on the volume of the new engine to be produced and where the engine was to be used. These assumptions were then given to the Engine Division to study the manufacturing costs, to estimate the type of facilities required, and to compare alternative sites for making the engine. After this planning was done by the Engine Division and approved by the company, the Engine Division took responsibilities for inviting bids for the production equipment and for managerial and engineering staffing of the chosen plant (the Dearborn Engine Plant). This basically top-down decision involving multiple departments and plants is found to be the case with Volkswagen, Renault, and other companies. The complexity of the decision process also implies a long lead time for major technological changes at a particular plant (e.g. 29 to 50 months at Volkswagen), and a long planning time horizon for technological change (e.g. four to six years at Volvo).

As already pointed out, the automobile industry is its own producer of product technology -- technology of the engine, the drive train, etc. However, the automobile industry is mainly a user of manufacturing technology and, depending on the specific cases, may or may not be involved in the development and production of manufacturing technology. Exceptions are Renault and Volkswagen which both develop and produce automated systems including industrial robots, as well as Volvo which builds its own automated press systems like the ones installed in the Olofström plant. By and large, automobile companies try to utilise their internal human resources that have the manufacturing know-how. For example, for the renovation of Ford's Dearborn Engine Plant, other Ford engine plants were looked to specifically for ideas, and expert personnel were shifted into Dearborn from other parts of the Company. For technological change in Toyota's Tsutsumi Plant, the Company's own stamping engineering staff, which had planned, designed and constructed about 100 stamping lines in Toyota plants, was engaged for its service to Tsutsumi. In Renault's case, the Renault group includes Renault-Machines-Outils (RMO) which is a machine tool manufacturer, and which provided the basic manufacturing equipment for producing stub axle carriers at the Le Mans Plant. In the case of Volkswagen, the Company happens to be the largest producer as well as the largest user of robots in Germany, and provided the robots used in the body shell shop at Hanover.

Of course, when the situation dictates, the automobile companies also acquire external technology, especially for manufacturing. In such circumstances, the equipment vendors play a key role in technology transfer

and diffusion. In Ford's renovation of its Dearborn Engine Plant, equipment vendors provided advice concerning particular hardware and participated in the training of operators, both in-plant and at the vendors' sites. The rapid development of high technology as CAD/CAM is likely to lead to the increased reliance by the automobile industry on external sources for improved manufacturing technology. The location of manufacturing plants overseas is likely to lead to increased teaming with outside consultants and engineering companies.

An interesting history of this process has been reported in the Volvo case study. The concept of simultaneous innovations of technology and work organisation (socio-technical innovation) was first introduced by external consultants, mostly behavioural scientists, prior to 1974. The idea was then internalised by the managers trained with this concept and who later rose in their positions and took the line responsibilities to put the idea into practice (between 1974 and 1980). The process by which job design has developed in Volvo is pragmatic to problem-solving and an appreciation of the potential energy which only man can mobilise. This process of internalising and adapting technology which originated externally appears to have also worked very well for the Japanese in product and equipment technologies, and seems to be working for Westerners who are examining, sifting and adapting some of the Japanese process technologies and management techniques to Western plants.

In the past, human resource considerations were not prominent at the early stages of business and product development strategies, but entered only in a subtle way. When location choice for production is considered, a global outlook is first taken to compare labour costs and capabilities in different countries. When alternative sites are compared in the same region or country, the consideration would include labour relations climate, labour quality, as well as labour costs. When specific technologies are considered, legal restrictions and collective bargaining agreements between the company and the unions would also be included in the comprehensive planning procedure.

The process of technological change is itself undergoing continuing changes. The trend in all the automobile companies involved in the five-country study is moving away from strict cost-benefit analysis of the tangible factors only. In making decisions on technological changes, more attention is given to the less tangible factors such as product quality, and to the long-term viability of the company's competitiveness. Additional improvements in the process of technological change fall under such themes as: consensus and commitment at the beginning of the process; sensitivity to external forces of market shifts, international competition and government regulation; employee participation; and better use of human resources. The climate within the automobile industry is clearly moving towards further improvement in communication and worker participation in decision-making related to technological changes.

3. Management of Change and the Proper Use of Technologies

As management implies getting things done through people, managerial style in this report refers to the philosophy, techniques and organisation through which humans are used for producing automobiles. As we have seen, process technology embraces both workers and machines. It is difficult to

draw a sharp demarcation line between process technology and managerial techniques, as both of them deal with the human element -- and, in fact, the Ford company report calls "managerial technology" the way in which the company's operations are planned and run. However, it is understood here that managerial techniques are more concerned with the human side of the production system, including the organisation of employees in the various line and staff positions in the company hierarchy as well as the workers on the shop floor.

Until the 1930s, the United States automobile industry was run by technological genius -- by people like Henry Ford. Nowhere in industry was there a well-developed capability in management as it is thought of today. Market growth and product equipment and process innovations had been sufficient to bring about phenomenal success. The managerial style was typically autocratic-- if it was judged to be benevolent, it was termed "paternalistic".

A new kind of genius appeared in the automotive industry in the person of Alfred P. Sloan. It was from his ideas about running General Motors that managerial technology really came into being. The Sloan concept was one of decentralised operations with co-ordinated control. During the 1940s -- in support of the United States effort in World War II -- managerial technology became more analytical. Systems planning and decision-making were developed along with sophisticated financial management techniques. The professional manager replaced the "genius" manager.

On quite another front, organised labour, under the protection of new labour laws that took very different forms in different countries, also became a powerful force that (differentially) affected the development and to some extent limited the choice of managerial technology of the local automobile industries. Thus in Japan, for example, the fact that automobile labour unions are company -- as distinct from national -- labour unions is conducive to close co-operation and mutual trust between labour and management within each company. In the United States, on the other hand, there is a long history of the United Auto Workers (UAW) successfully achieving significant economic gains in the form of wages and benefits and improving working conditions for all its members throughout the industry -- nationally. In Europe government legislation and even direct involvement are more prominent influences on labour relations. In France, Renault was nationalised in 1945 by an ordinance that specified, among other things, an operational principle based on worker participation. In Sweden, more than 20 new pieces of legislation came into force during the 1970s concerning labour relations. In Germany, there has been a closely meshed network of legal rulings influencing working conditions, work organisation and professional qualifications. The high degree of worker participation in Volkswagen's decision-making process concerning technical innovation, employment and work conditions reflects the influence of the 1972 Enterprise Constitution Act and the Worker Co-Determination Act.

Although there is a diversity of managerial technology development and practice in the automobile industry between countries, the general trend is towards increased worker participation in production decision-making. The quality circle approach, involving more off-line input and co-operation between workers and management, is considered important and is being either tried out or implemented by practically all major automobile companies around the world, although variations of the approach and different programme names

may be found in different companies (9). There is also a trend towards giving more on-line responsibilities to the worker, ranging from preventive maintenance to quality control, and to multi-process handling. Further development of managerial technology appears to be intertwined with new work organisation and training. For example, the increasing emphasis on "group work" is shifting the "one man-one machine" work organisation to the concept of "one group-one system". In order to have each member of the group capable of covering another member's work, all workers need to be trained to become multi-functional. All these new managerial techniques are aimed at the improvements of quality and productivity of the production system.

4. Technology as an Instrument for Managing Change

As already recalled, the human element is very much an integral part of technology, especially process and managerial technology -- indeed, the very substance of technological change is largely determined by human values and institutions, as well as human knowledge and creativity. Thus, on a more philosophical plane, technology is not an independent variable that calls for responses in terms of work organisation and training. Instead, all three (technology, work organisation and training) should be considered on an equal level, and all three may be regarded as instruments, among other possible ones, for accomplishing and managing desirable changes.

Since management has been judged to have greater potential than traditional technology in the achievement of quality, productivity, and other desirable objectives in the automobile industry, it is timely to review here the basic shift in management style that practically all major automobile companies around the world have undergone in recent years.

At the risk of over-simplification, one may say that this shift has stemmed from "Theory Y" of the human side of enterprise in the West (10), which is similar to the "Respect for Human" philosophy of management in the East (11). According to this concept, a good manager should be a leader in a democratic team, rather than an autocrat dictating to his subordinates. In practice, then, management by objective is secondary to management through consensus and commitment. Note that, in the new management style, management by objective is not totally abandoned, but the manager spends more of his time achieving consensus within his team as to the objectives that are both feasible and desirable. Through this process, the team becomes committed to the objectives and these can then be met more effectively and smoothly.

To exercise leadership in managing for change, the manager strives (though not always successfully) for his team to perceive the need for change, to share the same vision of the future, and to agree to a chosen set of instruments for change towards the visionary goal. To develop perceived needs for change, the team must be sensitive to, and discuss within itself, external forces (such as international competition and government regulation) and internal forces (such as workers' safety and quality of life) that are putting on the pressure. A shared vision of the future requires not only technological and social forecasts that are specifically relevant to the team but also an appreciation of realistic constraints and what the role of each member will be in the envisaged set-up. Instruments for change, as discussed previously, include but are not restricted to technology. Among the most

effective instruments available to top management are new policy letters, modified incentive systems, and the like, which create a positive climate for change, rather than the substantive technology, work organisation and training programmes that are instruments more suitable for middle management. In other words, top management has more leverage in managing change by shaping the technoculture of the company than by dictating specific technology for its products or production systems.

The concept of technoculture as found in VOV stands for the symbolic context that is created in the interplay between the physical (technique) and the symbolic (culture) reality of an organisation. Technoculture is thus the way in which the technique is framed in the symbolic reality of the organisation. Technoculture is a way of looking at change in a socio-historical context. Changes in traditions, norms, values and corporate rights are as important as the new technology in the change process for they will be reflected in attitudes towards training, development and recruitment.

That technology is only one of a number of possible instruments for change is shown, for example, in the product planning process we cited from Ford's engine plants. There, the time between the decision to build a new model car and the first such car rolling off the production line is usually several years. To be more responsive to market shifts, every automobile company would like to compress this time, which is required for complex interactions and decisions by design engineering, manufacturing engineering, the purchasing department, as well as other staff. One way to compress this time is through an integrated CAD/CAM system which can speed up the interactions and reduce engineering mistakes. However, the goal may also be reached by engineering work reorganisation that clarifies the authority for sign-offs and speeds up information flows. Rearranging the geographical proximity among the involved departments through architectural modification of the technical centre may also help. The challenge to management is to choose the appropriate mix of these various instruments, of which CAD/CAM technology is but one of many.

IV. EMPLOYMENT AND WORK ORGANISATION

Although the research carried out for the CERI project was focused on qualitative aspects of recent developments, it would leave an unbalanced picture if we were to say nothing of the employment aspects, which are very significant, considering the size and the role of the automobile industry in the economy and the magnitude of recent changes. Among the countries reviewed, it is in the U.S. that the sharpest decline in employment was recorded. Although much slower to show itself, the trend has also been downwards in the Federal Republic of Germany and even more so in France. It is only in Japan and in Sweden, thanks to a growing share of the market and a production increase, that employment levels could be maintained or slightly improved.

It is extremely hard to evaluate the impact, respectively, of the economic conditions, of increasing competition, of more efficient organisation and of new technologies on the employment situation. It seems clear that the

latter have not played a decisive role in the substantial variations that have taken place recently. But in the long run, and considering only the motor car industry, the new technologies are likely to contribute to maintaining or to accelerating a downward trend. It is often assumed that a robot can do the work of at least two production workers. Generally speaking, the primary objective of investment in automation is to improve productivity, therefore to reduce the workforce for a given level of production. Considering that the demand for cars is not expected to grow at a very fast pace, it is likely that employment in the motor car industry as a whole will continue to decrease, with wide differences among firms, according to their changing share of the market.

During the initial stage, production workers were the most directly concerned by this trend and were in many instances hard-hit by lay-offs. More recently, it has appeared that white-collar workers also can be concerned and that further productivity increases must be expected too in tertiary activities of the automobile industry (largely in connection with new developments of data processing, combined with a more efficient organisation).

This employment situation, which has led to a lower turnover and less new recruitment, has inspired unions to give greater emphasis to employment issues both for those workers who will stay and those who will be laid off. In both cases unions as well as management tend to highlight the importance of education and training, while many automobile companies are having to face up to the fact that, with a drastic reduction in the number of simple tasks, few unskilled jobs will be left. It would seem highly desirable to retrain unskilled workers for these new activities; but this would be an undertaking of considerable magnitude (in some countries at least) considering the low level of basic education of part of the labour force, its limited experience of further learning and of job variety and the fact that many workers are now relatively old. When the rate of job reduction becomes faster than the turnover, considerable effort will be required to develop suitable programmes and teaching methods.

Work organisation in the automobile industry was for a long period the prototype of the rigid work organisation inspired by Taylor and Ford and based on a high degree of division of labour. Simple and repetitive production tasks were performed by unskilled workers. Management was essentially concerned with the attainment of quantitative targets, implying that workers would follow the required pace and would be assigned to the right job place, taking into account a high level of absenteeism. Skilled work was increasingly confined to specific areas such as maintenance or tool-making.

This model has been challenged in several ways: workers expressed their dissatisfaction, either openly (dissatisfaction with work contributed to a number of strikes in various countries), or in a more indirect manner (absenteeism, turnover and sabotage). Management also became progressively aware of the negative impact of this type or organisation, in terms of quality and of cost; it also found it difficult to recruit personnel -- which led in many cases to the recruitment of migrant workers abroad. Around the 60s, it was again the automobile industry which was at the forefront for experimentation in new forms of work organisation, such as work enlargement, work enrichment, or semi-autonomous groups. In most cases, these were only isolated attempts and had a limited impact. But they paved the way for later

developments. Since the late 1970s, the context has evolved rapidly, with intensified competition, more emphasis put on quality and flexibility and the accelerated pace of automation. These new conditions have had, and will have in the near future, an important impact on work organisation and work relations.

It might naïvely be supposed that automation could lead to a factory without workers on the shop floor and that the human factor in industrial production would then become relatively negligible. The project case studies, however, are proof to the contrary, as even the most sophisticated equipment requires constant attention to monitor it, solve minor problems, identify and remedy the more important ones. Increasingly expensive investments have to be used to their full capacity, which was usually not the case with more traditional machines. Furthermore, in a context of increased competition, consumers are expecting a higher degree of quality. Moreover, it has become increasingly clear that engineering departments cannot conceive a perfect work organisation that will solve all the problems and that new resources for ideas and improvement could be tapped in the workers' minds. All of this requires more competent, more motivated, and more responsible workers in a different social context.

Recent improvements in work organisation, then, have been only one aspect of a broader process of change, which primarily involves human and industrial relations. For most companies participating in the project, technological change would not have been possible without this broader process.

A major issue that has to be stressed in relation to work organisation is that even if the introduction of more automated equipment is made the occasion for changing work organisation, it cannot determine what the new organisation will be. Much depends on the choice made, either at company or at plant level, in relation to available workers' qualifications and to specific policies regarding skills and the division of labour. The Renault case study proved this point, since the type of equipment analysed at the Le Mans plant was successfully put into operation in other plants which had very different types of work organisation.

Another point is that because of the need for more flexibility in the production system and for adaptation to technological change, work organisation on the whole is becoming less rigid than it used to be. A further common implication of new technology is the reduction in the proportion of simple and repetitive tasks that can be easily mechanised. This was the case for the various stages of manufacturing such as foundry, machining, and welding. It now begins to affect assembling. This reduction in jobs is only partly compensated by the increasing importance given to quality control and maintenance, but it will have a major impact on work organisation.

A strong general trend is the introduction of group work, or, as the Renault company report states, there is a trend away from "man-machine relations" towards "team technological systems relations." This involves restructuring the production process by setting teams which often number from three to eight people. This represents a move away from assembly-line structures with their isolating and alienating effects. However, and predictably -- given the diversity in the industry -- there is no uniformity.

In the first place, it is notable that group work existed before the introduction of the assembly line: in Volvo in the 1950s people worked as a team around each press, with a "press master", before the MTM system imposed specialisation and isolation. So it would be false to see the current stress on group work as the dawn of a new era. Secondly, the motivation behind its introduction ranges from the straightforward desire to keep production as continuous as possible to a more socio-psychological consciousness of the importance of defined territoriality. These aims need not be in conflict, but it is worth pointing to the essential difference in their parentage.

Again to be expected because of the diversity in the industry, these work groups are not at all the same in their composition. They may be made up of workers with more or less similar skills, each capable of carrying out the full range of tasks required; or they may be heterogeneous with a fairly well defined internal division of labour. In some cases there is a clear distinction between maintenance workers, transfer line controllers and other members of the group. In others, there is some uncertainty even about whether maintenance workers should be integrated into groups or kept apart as a separate category. So the notion of a "group" does not necessarily denote a particular level of social cohesion. It is evident that this variety (which again illustrates the diversity of application of new technologies) has substantial implications for human resource development, especially in the development of collective skills and the ability to work together.

In relation to the development of group work, it seems generally accepted that workers should become more multifunctional. For the company, this has obvious advantages, since they can be assigned to a variety of jobs, depending on the workload, absenteeism or other vagaries. For the workers, it may offer more variety, the opportunity to acquire more skills and may well influence their job classification and career development.

In terms of overall skill structure, the reduction in the proportion of simple tasks and the development of more skilled activities, of new job profiles and teamwork mean a general tendency towards upskilling. This goes against the previous trend, when the extension of mass production, the fragmentation of work and the first phase of automation had contributed to the deskilling of production workers. But a balanced view of the present trend, of its implications and of its limits has to be taken.

Changes in occupational classifications, formal or informal, are an important factor in the organisation of work. There is a clearly growing tension between existing classifications, noted either in the formal qualifications produced by initial education and training or in sheer tradition, and the changes generated in the nature of work by the pressure of technological change. In other words, the labels under which people work may not correspond closely to what they actually do.

In some cases, the hierarchy at work has up to now been strongly influenced by the points at which workers entered into the labour force, determined by the length and type of their formal training. Organisational change thus comes up against rigid structures, whose reform has implications at national level. This can be illustrated from Volkswagen, which operates within the highly developed and formally legitimated German training system. In general, this has been a source of strength, but it is at least

questionable whether such a deeply rooted system is capable of responding quickly to changes in work organisation.

The problem is not confined to the relationship with external classification systems. Every company will have its own defined occupational structure, which may have evolved over a long period of negotiation. Changes in this system, with its implications for the distribution of status and rewards, entails complex and sometimes conflictual renegotiations of existing skill and occupational categories.

The speed with which the changes in work organisation take place determines what might be called the "utilisation lag". People may acquire skills, externally or internally, but unless the path is cleared for an appropriate redivision of labour, they will not be able to apply these skills. It is difficult to discern whether changes in work organisation are generated by the presence of newly skilled workers or whether skills are acquired in response to work organisation -- "push" and "pull" factors respectively.

The outcome of the major renegotiations to which we have just referred is, of course, the emergence of new job profiles, with certain categories showing prominently either as benefiting or with particular problems. Maintenance workers are an existing category who have universally acquired a wider range of skills. Where maintenance is kept as a separate function, these workers form something of a labour aristocracy, acquiring new skills and exercising an enhanced degree of power. This may exacerbate divisions within the labour force, as appears to have been the case at Ford. Another existing category with different prospects is that of supervisor. The knowledge on which their superior position is based is often eroded, the organisational structure which has supported them has altered (Volvo, Volkswagen), and new roles have had to be found for them.

The position is complicated by the emergence of <u>new</u> categories of workers, notably the CCUA in Renault and the <u>Strassenführer</u> in Volkswagen. These represent prominent examples of a regrouping of functions. Their place in the product system can be quite easily understood from the technical point of view; much more difficult to gauge is the way in which such new categories affect the social organisation. This is true at more than one level. Within the production group their role is still fluid; and their impact on the company's occupational structure and salary system is also uncertain. Management will clearly be keen to develop new occupations which meet the requirements of new technology, and also to offer attractive prospects to the job-holders. On the other hand, they will be reluctant to concede upgradings which carry with them marked increases in the wages bill.

<u>Internal labour markets</u> are becoming increasingly important. In some cases it is being argued that technological change can only be implemented if there is some degre of employment stability; however, this presents an obvious dilemma when set against the need for flexibility and the reduction of overall employment. Job security and promotion prospects are both obvious targets, but are hard to achieve against a background of flux and uncertainty. One apparently universal feature is a growing gulf between a core labour force that enjoys at least a relative improvement in its labour market situation,

and a range of peripheral groups who are threatened by the introduction of new technologies.

Age structure is a persistent theme. Seniority and long-service rights have increased the average age of the labour force and also influenced decisions on who fits in where in the reshaped work structure. This was especially the case at Ford, with its "bumping" system, based on seniority rules. Again, there is a tension here. On the one hand, experience is valued, perhaps more than formal qualifications. Moreover, the achievement of social integration depends in part on loyalty being seen to be rewarded. On the other hand, there seem to be different views as to whether or not older workers may be regarded as the most appropriate people to handle technological innovation and to acquire new skills.

A few other points should be made under the heading of work organisation. Health and safety considerations continue to be a matter for concern. New technology generally, though not invariably, reduces physical stress in its currently known forms. But noise remains a particular problem in the car industry, and new forms of physical threat may emerge, for example, from the intensive use of VDU screens. Moreover, the concept of health and safety is being expanded to include psychological aspects.

There is also the question of job satisfaction. Many of the trends identified suggest that those who have retained their jobs may be in work that is qualitatively somewhat better than earlier work in the car industry. More evaluation needs to be done on this. But assessments of the implications of new technology for job satisfaction must be set against those same employment trends: people are more likely to express satisfaction if the alternative to an unsatisfactory job is no job at all.

New technologies also have an impact on the flexibility of working time. In some cases, and because the new technologies have to be fully utilised, new ways of organising the work-week and shift-work are emerging. Even if the reports do not elaborate very much on this, it is plausible that this development will be important for the future both as it relates to work organisation and to the wage systems.

Finally it has to be stressed that even if there are economic, technological and social forces in favour of change, one should not underestimate the inertia of organisational structures and the conservatism which is rooted in people's minds. Change in work organisation requires full commitment of management and cooperation with unions, and it has to overcome frequent resistance on the part of middle-level management.

V. TRAINING AND EDUCATION

The discussion of changes taking place in work organisation, job content and skills, obviously has important implications for the training of workers. Issues related to this situation go beyond purely vocational training and involve education in the broader sense.

To start with actual developments in the automobile industry, a common trend is the growing importance attached to training by all the firms covered by the CERI study. However, it is very difficult to quantify this effort and there is at this stage no possibility of a meaningful comparison of the overall training effort in a straightforward quantitative sense. Whereas in the French context, the law makes it compulsory for companies to spend a minimum percentage of their salaries on training, which implies a specific accounting, in other countries a number of items are not necessarily accounted for, such as the trainees' salaries or the time spent by management on training. This is especially the case at Toyota, where training is considered a paramount role of management at different levels. Furthermore, training is closely interrelated with most changes in the production process and in work organisation, which makes it difficult to estimate its costs and results.

In most of the companies observed, there would seem to be fewer direct links than expected between technological innovation and formal training. This might seem surprising, given the conventional rhetoric about the need for training and skills. It may result from both the difficulty which is often met in assessing future requirements and some inertia on the part of the structures responsible for training. Insofar as the process of change involves feedback and communication between different agents and a series of continuous adjustments and re-adjustments, it is difficult to draw up a coherent training schedule. The process of innovation is itself experimental, so that it is difficult to specify clearly beforehand what the training implications will be. All these factors point to an inbuilt training lag, with trainers constantly at a disadvantage in their attempts to catch up with, let alone anticipate, technological innovations.

The cost of this time lag, in terms of under-utilisation of new production capacities due to inadequate education and training of workers, has led some of the companies to understand that decisions concerning investments and planning of human resources should take place at the same time as investments in new technology and that the two should be closely coordinated. This means early discussion of work organisation, with implications for skills and training.

We began our review of work organisation by referring to group work. There is some parallel here with an emphasis on collective learning. However, this is patchy. Just as some of the group work exhibits clear internal division of labour, so the skills are often acquired in individualist fashion. On the other hand, the idea that group work cannot be successfully achieved unless the group as a whole follows a common learning path is clearly central to some approaches: in Volvo, the production group development activities are identified as one of the most remarkable components of the whole human resource policy, and collective evaluation is prominent in Toyota.

The divide between individual and collective approaches poses further problems for a formal education system which is largely geared, in method and philosophy, to individualised approaches. There is a degree of potential irony here, in that in the educational field new technology holds out the promise of highly sophisticated individual learning programmes; whether these are appropriate for the acquisition of skills in industrial production is another matter.

There is an undoubted stress on polyvalence -- the acquisition of a range of skills. This applies mostly to the functional redivision of labour where a single worker combines functions which previously would have been allotted to several, operating at roughly the same occupational level. Rarer is the recombination of skills from different levels of the occupational hierarchy. The notion of a "rainbow-collar" worker might be worth exploring in this context, as someone with skills which span the existing and the emerging vertical and horizontal job functions.

It would seem that hitherto most of the training activities have been concerned with the acquisition of technical skills by technicians and highly skilled workers. Now, however, there is a growing concern for a broader type of training or education for all categories of personnel. That training should not be limited to technical skills has long been the policy at, for instance, Toyota, where educational programmes aim at developing personal abilities, creative potential and an understanding of the company situation. This approach is linked with the practice of quality circles, which may be considered as an educational activity, and of different suggestions systems. More general education for young workers, in particular, develops an awareness of what it means to be part of a company -- in other words, contributes to the worker's integration and thereby forms a contribution to the development of a "company culture".

In other companies, and especially at Volkswagen and Volvo, there is a growing concern for a more global approach, which would substitute the concept of competence for the traditional concept of skill. Whereas the latter would be limited to professional matters, competence would also include personality development and social ability to work as a member of a group. Emphasis is now being put on key qualifications which are in fact common to professional activities and to private life, such as ability to learn on a lifelong basis, to communicate, to cooperate, to plan, creativity, capacity for resolution of conflict on a rational basis, responsibility.

It is felt that, although these qualifications may not seem directly related to technological change, they constitute a prerequisite for it. Such a broad and long-term view of personal development is all the more necessary if it does not seem possible to forecast future professional requirements.

In other words, whereas the traditional learning process aimed at a specific goal, to be reached in a prescribed way and at a given stage, what is increasingly required now is to learn how to react to changing conditions. The learning process should be conceived as an open one, with a broad vision of the goal, but this goal may change with time, so that a constant and mutual adaptation is necessary. It is also felt that shifting emphasis from skill to competence would mean giving more attention to the group rather than to the individual and to competences that are actually used and not only potential.

This conception of education and training for competence on a lifelong basis -- which has sometimes been called holistic and which turns away from the functional performance of a specific task -- entails far-reaching implications, not only for the content of training programmes, but also for their management and organisation, and for teaching methods. It is a concept that needs to be taken into serious consideration during the refurbishment of curricula in formal education.

At this early stage in a fundamentally changing picture, it is not surprising that strict evaluation of training is virtually absent, and may even be regarded as a fruitless task; nor does the management of training exhibit any clear patterns. Generally, though, the reports reveal that the significance of technological change is forcing managements to pay more attention to training than in the past -- indeed, in a number of the companies, the identification of training needs is already established as an integral part of the management function.

Recognition of the importance of training sometimes expresses itself in the creation of a separate training function, or, conversely, it may be decentralised "to increase the responsiveness of the function and target resources more specifically to identified needs", as in the case of Ford. Another option is to centralise the capital-intensive training centres for new technologies while retaining decentralisation for general training, as is the case of Volkswagen at Wolfsburg and of Renault.

Another point concerns the actual sources of provision of training and in particular the balance to be sought between internal and external sources. Although in some instances companies are relying on outside providers for special training needs, the overwhelming bulk of training is employer-provided and takes place either in the plant or in some training facility on the company's premises. Training by vendors of new machinery seems to be limited to the initial stage of its installation and is often provided as part of a package deal which includes initial training for the new equipment. There are some interesting examples of outside training of company personnel in institutions of secondary and post-secondary education and training, as evidenced in most of the company reports. On the whole, however, companies of the size of the five enterprises that have participated in the case study have sufficient qualified manpower and expertise to carry out their own training programmes. An important question is, of course, to what extent this training capacity can and should be used for workers who will be laid off. The initiatives taken by Ford in this respect are particularly worth watching.

At this stage, it is interesting to speculate on the outcome of two coexistent trends. On the one hand, several companies are insisting on the growing role that they should play in the educational process, on the grounds that the type of training that they can provide is less academic, more concrete and therefore more efficient than what the schools can offer. So they tend to favour a kind of de-schooling process. At the same time, the goals that they would like to assign to such training and its content are so broad that they would seem to belong already to the established province of formal education. This is a paradoxical situation that would justify further analysis, not least in relation to the present wide-ranging debate on the quality of formal education.

Finally, and as a concluding remark to this synthesis, there seems little doubt that any company will actively or explicitly downplay the importance of the human resource in policies designed to meet the challenge of technological incursion -- in other words, to suggest that the labour force and the skills it embodies should be subordinate to the dictates of technological change. But the nature of the commitment remains less clear, as companies face both the uncertain fluctuations of the world automobile market

and the inherent problems of technological innovation. Nevertheless, there appears to be a growing acknowledgement of one fundamental principle: the redivision of labour cannot be accomplished without labour itself playing a major part. In spite of the complexity of corporate planning, and the lag between original conception and actual production, there is a tighter interdependence than ever before between different organisational levels. The paradox in this for human resource policy can be summed up as follows: on the one hand, a major necessary condition for the successful management of technological change is the development and utilisation of a host of new skills; on the other hand, these skills can only be acquired in the actual process of change itself.

NOTES AND REFERENCES

1. This section draws from an earlier draft by Darlene Nichols, University of Michigan, Ann Arbor, who was a member of the United States research team.

2. The Secretariat wishes to acknowledge the help of Ms. Darlene Nichols, University of Michigan, Ann Arbor, and of Mr. Fujiwara, University of Nanzan, Nagoya, in the preparation of this section.

3. This chapter draws from a paper prepared by Prof. Kan Chen of the University of Michigan, Ann Arbor, who was the head of the United States research team.

4. Cf. Arthur Anderson & Co., "United States Automotive Industry in the 1980s: A Domestic and Worldwide Perspective -- The Second Delphi Forecast", July 1981 (69 West Washington Street, Chicago, Illinois 60602, United States), 1981.

5. Cf. University of Michigan Transportation Research Institute, "U-M Forecasts for the United States Auto Industry through 1992 -- Selected Results from a 1983 Delphi Study" (2901 Baxton Road, Ann Arbor, Michigan 48109, United States), 1983.

6. University of Michigan Center for Japanese Studies, "Joint United States/Japan Automotive Study: Final Report" (Ann Arbor, Michigan 48109, United States), January 1984.

7. Joint United States/Japan Automotive Study, op. cit.

8. Yasuhiro Monden, "What Makes the Toyota System Really Tick?", Industrial Engineering, January 1981.

9. Cf. Arthur Andersen & Co., op. cit.

10. Douglas McGregor, Human Side of Enterprise, McGraw, 1960.

11. Cf. Y. Sugimori, K. Kusunoki, F. Cho and S. Uchikawa, "Toyota Production System and Kanban System -- Materialisation of Just-In-Time and Respect-for-Human System", Pre-Print 3.12, Fourth International Conference on Production Research, Tokyo;
Cf. also R. Muramatsu, Production Planning and Production Control (in Japanese), Kigyo-Shindan-Tsushin-Gakuin, 1977.

Annex

THE AUTOMOBILE MANUFACTURING ENTERPRISES PARTICIPATING IN THE PRESENT CASE STUDY : FACTS AND FIGURES

Because it is not the intention publicly to issue the company or research reports which have provided the substance for the present review and synthesis; and because, too, we have attempted to present a conspectus that is global rather than piecemeal, some sense of unreality may persist in the reader's mind if he is left without the means to visualise, as it were, each of the five companies with all their differences.

To remedy this, the following observations have been extracted (most largely) from the companies' reports upon themselves.

I. FORD MOTOR COMPANY

1. The Company

General

Ford Motor Company is in its 81st year in business. When it began in 1903, it was but a tiny operation in a converted Detroit wagon factory staffed with ten people. Today, Ford is a multinational enterprise with manufacturing, assembly, and sales operations in 29 countries on five continents. More than 375 000 men and women come to work each day in its factories, laboratories and offices around the world. Ford products are sold in about 160 countries and territories. Annual sales -- over $44 billion in 1983 -- exceed the gross national product of many nations.

In 1914, Ford introduced the moving assembly line and reduced the labour hours in final assembly from 12 hours and 28 minutes to one hour and 33 minutes.

At the very time the moving assembly line was being installed, Ford revolutionised the workplace in two other important ways -- by reducing the workday to eight hours, and by doubling wages to $5 per day. Until that time,

the Company had labour turnover rates approaching 60 per cent per month and these innovations brought relative stability -- and thus greater efficiency -- to the operation.

Within the last several years, technological change within Ford Motor Company has been product driven. From 1977 through 1983, Ford introduced 23 new cars, seven new trucks, and 30 new powertrain components for the United States market. In the last two years, it introduced six new cars and two new trucks -- at a cost of over $3 billion.

Industrial Relations

For the past forty years, virtually all of Ford Motor Company United States production and skilled trades workers have been represented by the United Automobile Workers (UAW). In the earliest relationship, where recognition was being sought, the relationship between the Company and the Union was confrontational. After several years of attempted organisation, the Company recognised the Union as the collective bargaining agent for most blue-collar workers. The first Collective Bargaining Agreement between Ford and the UAW was signed in 1941. As the early relationship developed, agreements became complex and legalistic and the relationship remained largely adversarial.

In its first thirty years, the UAW was particularly successful in achieving for its members significant economic gains in the form of wages and benefits, and in improving plant working conditions. Labour-management relationships matured and were characterised by mutual accommodation and literal labour agreement administration. These relationships were punctuated by negotiations, usually every three years, over basic terms. There were pattern agreements among the United States companies with little, if any, need to regard for foreign competition.

In the early 1970s, while a great deal of attention was being given to the increasing influence of public policy, two kinds of recognition of a common social change were occurring in the automobile industry. In some companies, a few plants were becoming known for improvement through various forms of worker participation; other plants were becoming known for a kind of disruption that was termed "blue-collar blues". In both instances, changing worker values were being manifested. During the 1970s, while much of the management research and modern management philosophy became strongly supportive of a participative style, Ford had moved only moderately from the "scientific management" practices of Taylor and the strategic, analytical, top-down style which saw human resources merely as one element of the production system. The UAW, on its part, was only beginning to establish a clear focus for special efforts in this area.

In the late 1970s, it became apparent to both the UAW and Ford that they must address issues of worker dissatisfaction, work alienation and changing worker values, as well as that of work organisation and management styles, in order to provide a more satisfying workplace and produce quality products more efficiently.

In 1979, steps were taken jointly with the UAW to begin creation of a new work climate and relationship. This initiative was called Employee Involvement.

Also in 1979, the UAW recognised that increasing technological innovation in the workplace would be necessary if Company operations were to maintain competitive capability and if long-term job security for its membership were to be achieved. However, the Union was concerned about lack of required skills and worker displacement implications. Accordingly, a Letter of Understanding with the UAW on New Technology also became a part of the collective bargaining relationship.

The 1979 Agreement included not only these two new documents, but was characterised by a spirit of recognition by both parties that certain mutual goals could be jointly identified and pursued. This new spirit, in fact, set the stage for the beginning of a new relationship between Ford Motor Company and the UAW.

As the relationship grew under this Agreement, certain changes became evident. There was more dialogue, more open communication, and more information sharing. Broader goals were discussed and additional avenues of mutual interest and action were developed. Mutual trust began to emerge. The cornerstone of this change was Employee Involvement.

While this new relationship was developing, the overall business climate was eroding rapidly. The combination of another oil shock, a national recession and mounting foreign penetration of the United States market resulted in financial and human chaos. In mid-1979, there were approximately 202 000 UAW-represented employees on the rolls in Ford United States facilities. By the end of 1981, this number had dropped to just over 100 000 -- a 50 per cent loss in employment for Ford and in active membership at Ford for the UAW. It was apparent that action was needed by all parties, including the UAW, to help preserve the Company and contribute to a recovery.

In February 1982, a new agreement was reached. It contained many innovative features including moderation in the rate of labour cost increases, profit sharing, new forms of job security and new avenues for mutual effort. It also provided a critical 30 months of labour peace and stability (through the most intense new-product introduction period in Company history).

Training and Development

Under the provision of the 1982 UAW-Ford Collective Bargaining Agreement, a new Employee Development and Training Program (EDTP) was established. Major elements are the establishment of a Joint Governing Body and construction of a new National Development and Training Center.

This is a unique joint labour-management programme through which funds are allocated by the Joint Governing Body to contract with both public and private sector institutions to meet the needs of UAW-represented Ford employees -- both active and those on lay-off. It is incremental to traditional Company-provided training and will help meet job security and

career development needs of the hourly workforce. The EDTP is funded by $0.05 for each hour worked by a UAW-represented employee in the United States (about $10 million per year).

The principal objectives of the Employee Development and Training Program are the following:

-- Provide individual and group training, retraining and developmental opportunities to enhance the dignity and on-the-job skills and abilities of employees which can lead to greater job security and personal development;

-- Seek ways of arranging (and, in some cases, providing) for training, retraining and development assistance for employees displaced by new technologies, new production techniques and shifts in customer product preference. Similar efforts would be undertaken for employees displaced as a result of facility closings or discontinuances of operations;

-- Energise, sustain and support local and national Employee Involvement efforts under the UAW-Ford Employee Involvement process. Provide research and studies in new techniques and methods to further Employee Involvement and other co-operative efforts between the Company and the UAW;

-- Provide opportunities for the exchange of ideas and innovations with respect to employee development and training needs within the framework of job requirements and union/management relations.

Reflecting in part the UAW-Ford Employee Development and Training Program concepts, a companion programme titled the Human Resource Development Plan was put in place for the salaried workforce. Funds for this Plan were approved at $100 per employee per year, which generates between $5 and $6 million annually.

2. The Dearborn Engine Plant

The Dearborn Engine Plant (DEP) is located in Dearborn, Michigan, at the Ford Rouge Complex. The plant was built in 1941, by the United States Government, to manufacture aircraft engines. In 1947 after the end of World War II this plant was purchased by Ford Motor Company, initially as a parts warehouse and, since the early 1950s, mainly to produce automobile engines. The construction of the plant is unusual for an engine plant in that it is a two-storey manufacturing facility.

By the mid-1970s, the manufacturing facilities in this plant, where V8 engines had been built for large passenger cars and trucks, became outdated. Between 1978 and 1980, a $600 million rehabilitation and expansion converted the facilities to produce 1.3/1.6 litre engines, accompanied by significant technological changes, especially in the form of computer-aided automation. About 5 000 people had been employed to work in DEP. It is said

that Mr Henry Ford II was involved in making the decision to locate the new facilities at DEP, instead of some new location, in order to keep the workforce in Dearborn. The plant has the capacity to produce about 3 000 engines per day, or about one million engines per year. Practically all workers have over ten years' experience due to a considerable reduction in personnel in the plant and in the Ford Rouge Complex based upon seniority.

The plant was selected for the CERI case study for two principal reasons. First, significant technological changes took place at DEP fairly recently and within a relatively short period. It was therefore feasible to interview various parties to get their impressions of the plant and their work, before and after the plant renovation. Second, many people at the plant have been interested and have actively supported or participated in training programmes. In fact, there is a new learning centre located within DEP.

For a functional unit within DEP, where research would be conducted, the crankshaft line was selected. This unit had undergone massive renovation in which job changes were significant, fewer workers were needed to run the operation, and additional training was necessary.

II. TOYOTA MOTOR CORPORATION

1. The Company

Development

Toyota began to manufacture automobiles around 1933 in Toyoda Automatic Loom Works. Kiichiro Toyoda, founder of Toyota Motor Company, carried on the work of his father Sakichi Toyoda -- a famous inventor of automatic looms in the late 1800s -- while setting about to learn automobile production technology to be created entirely by Japanese brains and skills. Toyota Motor Company was founded in 1937 to produce passenger cars but was slow in its development during and immediately after the War, due to a variety of factors, including shortages of raw materials and lack of a sound financial basis.

Toyota also had difficulty raising funds, and in 1950 its manufacturing and sales operations had to be made into two separate companies as a condition to obtain finance (former Toyota Motor Sales Company, Ltd., established).

In the 1950s, the Company was rocked by severe labour disputes. Important personnel cuts were made, and management took responsibility for the problems and resigned. This harsh experience confirmed for both labour and management the importance of mutual trust, and efforts were made throughout the company to reduce costs and fortify the corporate structure.

After settlement of the last of these labour disputes, and in order to prepare for further growth at Toyota, Eiji Toyoda (now Chairman) and the late Shoichi Saito (former Chairman) were sent to Ford Motor Company in the United States to observe and study Ford's production engineering and management practices, with a view to their possible introduction at Toyota. The highly

successful suggestion system seen in Toyota today was introduced after that trip and was refined over the years.

In 1953, Japan signed a peace treaty that returned full sovereignty to the nation. After the end of the Allied Occupation, restrictions on the importation of motor vehicles were relaxed, and companies in Europe and the United States began to export vehicles to Japan as demand rose. At this stage, a number of Japanese manufacturers signed technical agreements with foreign makers in 1952 and 1953 and obtained know-how from them. Among these were Nissan and Austin (United Kingdom), Hino and Renault (France), and Isuzu and Rootes (United Kingdom).

Toyota also considered the possibility of technical co-operation with foreign producers, but opted for a policy -- based on the spirit of the founder -- of manufacturing entirely domestically-made vehicles, utilising Japanese brains and skills to the fullest. Steps were then also taken to augment the Company's technological resources and allow it to start overall automotive research. Starting with the development of the Toyopet Crown, Toyota began offering a line of passenger car models.

Although total average monthly sales of all passenger cars in Japan in 1958 were only about 4 000 units, Toyota took steps to prepare for the nation's motorisation and built a plant in 1959 that alone had a production capacity of 5 000 units per month. That was the Motomachi Plant, Japan's first automobile plant built exclusively for passenger cars.

The sales division, moreover, started laying the groundwork for motorisation by establishing driving schools and mechanic schools. At the same time, it took steps to build large volume sales and after-sales service networks by introducing a system of multiple sales channels and organising a nationwide parts supply system.

The automobile industry underwent rapid expansion, together with the high growth of Japan's economy, from the first half of the 1960s. Beginning with the Toyota Corolla, the Japanese automobile manufacturers started introducing new models and improving existing ones.

In 1967, Japan overtook West Germany to become the world's second largest manufacturer in production volume, and demands intensified for Japan to liberalise its restrictions on capital. Restrictions for the automobile sector were lifted in 1971, and all Japanese automobile producers took further steps to bolster their production systems, augment sales networks, expand their own capital reserves, and strengthen their technical development capabilities. Toyota built several new plants in succession around this time: the Kamigo Plant in 1965; the Takaoka Plant in 1966; the Miyoshi Plant in 1968; and the Tsutsumi Plant in 1970. Toyota thus moved to put its production system into order in response to the market's expansion, and, around the same time, entered into business tie-ups with Hino Motors, Ltd., in 1966, and with Daihatsu Motor Company, Ltd., in 1967.

Against a severe backdrop, as a consequence of the oil price shock in 1973, automobile production in Japan in 1980 surpassed eleven million vehicles, with Toyota producing three million of them. Japan thus became the

world's top automobile-producing nation, and Toyota became the world's second largest automobile company.

All manufacturers continued to work to produce vehicles with better fuel efficiency and to carry out further pollution countermeasures while striving to meet society's diversified needs.

In order to respond quickly to the needs of customers, Toyota in 1982 merged its manufacturing and sales divisions, which had been independent companies since 1950, making a new start as Toyota Motor Corporation.

Industrial and Human Relations

Three distinguishing features are characteristic of the working environment in Japan generally: 1) equality for all employees; 2) practice of employment until retirement (most Japanese employees stay with the same company); and 3) company labour unions.

The first feature, equality for all employees, means that all Company employees are given positions that fit their capabilities and efforts, and all are treated accordingly. This is reflected in the fact that almost all directors in Japanese companies have always worked in the same companies they now manage. This factor also affects the manner in which work is accomplished, and has generated a pattern of co-operation in which each employee actively expresses his opinions. That is the background against which the Company is managed through a skilful blending of top-down and bottom-up interaction among personnel.

The second feature, the system of employment until retirement, offers certain advantages to the employee and the Company. Since most employees stay with the same company, the company can invest in education and training with the future of each employee in mind, each employee's capabilities can be developed over the long term, and the company realises benefits over the long term in management operations. Since employees are almost never laid off, the system allows them to relax concerning their future and to devote themselves to their jobs. Also, job rotation is implemented within each company so that employees can enhance their performance levels by learning jobs in different fields.

The third feature, the system of company labour unions, allows the company and the union to stand on a common ground rather easily. When the two parties have differences in attitudes arising from their different standpoints, this system makes it possible for them to communicate and deepen mutual understanding through a continuing dialogue, which diminishes their differences. In Toyota, too, sincere mutual consideration is given to the viewpoints of both labour and management, and both sides make every effort to discover points of mutual agreement.

The present stable relationship between labour and management at Toyota was built through constant dialogue between the two sides after the bitter experience of the afore-mentioned dispute, and the efforts to maintain the stable relationship continue even today.

Two features characterise the basic spirit governing relations between labour and management: first, that improved conditions for employees, both in their work and in their private lives, were inseparably linked with the development of the corporation; and second, that without mutual trust between management and the union, corporate growth was impossible. Nothing was more important for achieving these ends than extensive dialogue leading to mutual understanding, and both sides at last came to share the common perception and belief that corporate development and maintenance, and improvement of labour conditions, must come from improved productivity.

The principle of dialogue which underlies the fundamental spirit of labour/management relations as described above is applied at all corporate levels. The major forums are the Labour/Management Deliberation Council and the Labour/Management Discussion. These assemblies are attended by nearly all Toyota executives, including the Chairman and the President. Shop-level conferences are held between labour and management at all levels in the plants and at all jobsites (departments, sections).

Mutual trust between labour and management can only be established through the relationship of trust and sincerity that emerges from interaction among personnel on an individual basis at jobsites. And it is good human relations at all jobsites which form the cornerstone not only of good labour/management relations but for all corporate activities. In that context, Toyota promotes numerous activities to foster good human relations. More specifically, it organises groups on the basis of level of work responsibility, home residence, or other common factors for all personnel, extending from executives to ordinary employees. And the group members strive for mutual friendship and enlightenment through social gatherings, events and other activities. In particular, Toyota has what it calls its Personal Touch Movement, in which groups led by middle-rank workers at each jobsite meet to talk about matters of common interest. At these meetings, supervisors such as foremen, assistant foremen and playing leaders, also sometimes attend as advisors and to exchange opinions.

The corporate climate at Toyota, where emphasis is placed on dialogue as a means of smoother intra-corporate communication, plays a significant role in the development of multifunction workers who are capable of coming up with ideas, the implementation of other education and training, production control and the understanding by workers of new technology being introduced.

In Japan, the school year at all education levels ends in March, and just as is the general practice in Japan, Toyota basically hires its new employees in April each year from among new graduates. To guarantee the securing of human resources, Toyota strives to employ personnel with a diverse range of skills. Emphasis is placed on those applicants who are vigorous, healthy and have a co-operative nature, a broad range of basic knowledge, and other positive attributes.

Training and Development

Identifying an employee's capabilities and aptitudes is viewed to be vital for allowing each employee to realise his full potential, and to channel his efforts into areas which will most benefit the Company. At Toyota these

factors are identified primarily by the managers and supervisors at each working unit through daily performance. But as a supplementary measure, activities such as self-reports (introduced in August 1969) and periodic personnel department interviews, are also used. These measures are aimed at identifying the capabilities and aptitudes of individuals from various standpoints, as accurately and objectively as possible.

In order to develop and realise the potential of an individual employee to the fullest, it is basic Toyota philosophy that the employee himself must have a will to work and make the efforts needed. And one of the important duties of supervisors at each level of work responsibility is to educate their subordinates. They do this by creating the opportunities for education as well as actually guiding and helping their subordinates. As concrete measures, education and the rotation of employees purely for their personal development -- rather than for work requirements -- are actively carried out.

Comprehensive evaluation of capabilities and performance, based on factors such as the job requirements at different working levels and levels of responsibility, is a major consideration in most personnel management programmes. But at Toyota, special importance is also placed on relating this consideration to the development of each individual. Through promotion to higher positions, moreover, the Company attempts to stimulate the individual and motivate him to develop and improve his talents by assigning him to tasks with greater responsibility. For ensuring efficiency in the overall organisation, employees are promoted, not only for their business knowledge, skills and supervisory capabilities, but also after an overall evaluation of them as human beings.

Education and training at Toyota is aimed at "developing human resources that will help the company to develop". Toyota believes that educating personnel is not a matter of moulding them within a set framework: the important thing is to realise each person's individual qualities and characteristics. Moreover, the Company believes that a variety of activities provides a venue for developing personnel. Thus, in Toyota specific training/education programmes are carried out with the following three aims which are the common base for educating and developing personnel by strengthening their abilities and the will to work.

-- Development of personnel who can respond flexibly in their work: since the rapid development of society often makes the knowledge and information acquired at ordinary schools and other educational institutions insufficient by itself, Toyota educates its employees further to provide them with requisite knowledge and skills;

-- Development of personnel who understand the Company situation: employees are encouraged to understand Company policy, its business results, the way the company operates, and their own positions in the company;

-- Development of creative personnel: the Company makes efforts to develop the ability of employees to create ideas by themselves. Employees are instructed in methods and procedures for work improvement and for making suggestions.

Areas for education/training can be roughly divided into "job performance", "collective education" and "voluntary activities".

Of the three, "job performance" is the nucleus, and OJT provided through work and operations at each jobsite by superiors and by colleagues with longer work experience plays an important role. In addition, Toyota believes that the fundamental task of managers is to train their subordinates, and this can be said to facilitate the smooth progress of OJT.

The Company conducts educational activities in the following three areas, depending on specific function:

-- Education and training related to jobs at each jobsite;

-- Education for levels of work responsibility, and education for job functions;

-- Other education by function (quality circle education, safety and health education, etc.).

Concerning education and training at jobsites, each production jobsite has an on-the-job training system by which each section or subsection provides training to enable quick adaptation to new technology and early acquisition of skills by new employees and those transferred from other posts. For example, in a certain section related to maintenance, standards of knowledge and skill have been set for each level of work responsibility, and a summary sheet of the work required for each kind of machine is prepared.

From the knowledge aspect, the section starts by providing a general education, which covers such items as how to write a suggestion. It also provides specialised education, such as in programmable controllers, or education in designated fields of work, such as the safety and health aspects of specific tasks, or education for acquiring licences in national examinations.

The section then prepares a skill evaluation chart which lists each shop worker individually. An objective evaluation is clearly provided for each worker concerning the level of skill acquired in each type of work. An individual education/training chart is then prepared for pinpointing the work areas in which each worker is not yet proficient, and education and training are carried out systematically to develop multi-skilled workers.

Moreover, in a certain section related to a machining process, the educational plan for making all shop workers multifunctional includes the preparation, in each work group led by an assistant foreman, of a work training plan. The aim of this plan is to divide all the work processes of the group into work units that stand by themselves, and to train and educate each worker to be proficient in all of the processes. The assistant foreman drafts the plan for this training and education.

By promoting an increase in multifunction workers this way, day-to-day mobility within and between each group is increased, and personnel flexibility is attained for production changes, for utilising fewer workers, and other such situations.

OJT by rotation within the work group is important and even indispensable to nurturing multifunction workers. With human relationships built up through learning and teaching together in this way, the skills and know-how accumulated by specific workers are steadily passed on to newer colleagues and diffused smoothly throughout the jobsite.

In addition to the on-the-job training, there is an Education and Training Department as well as separate sections in each plant which deal with personnel management and education/training. These sections provide collective courses for all workers, such as general introduction courses for newcomers. The Education and Training Department, originally a part of the Personnel Department which became independent in 1969, provides a variety of courses to different categories of employees, ranging from training courses for future managers and supervisors to specialised courses concerning new technologies for production workers. While the Department carries out the various programmes with around one hundred staff members of its own, these latter courses are given by some twenty experienced supervisors or outstanding shop workers who are seconded to the Training Department for two years.

2. The Tsutsumi Plant

The Tsutsumi plant was set up and started operation in 1972. Like the other Toyota plants and the major suppliers of car parts, it is located in the immediate vicinity of Toyota Headquarters. The Tsutsumi plant is one of five Toyota plants, each of which has a press (stamping) shop, a body shell shop, a painting shop and a final assembly. The plants of other car-producing companies belonging to the Toyota group and producing Toyota automobiles, have their own press shops. Consequently, the Tsutsumi press shop, which was selected as the unit where research was to be conducted, produces parts mainly for cars to be assembled on the same site but there is marginal production for assembly at others.

The machines that were installed in the press shop at the time when the plant started operations comprised manual-fed press lines, semi-automatic press lines, high speed transfer press machines and blanking machines. Starting in 1973, new transfer press machines and automatic press lines were introduced but did not go into operation before 1972 -- due to the slackening production in the wake of the oil price shock. In 1978, transfer press machines which were able to process coiled materials were installed.

There are some 375 workers in the press shop. This figure includes production teams, personnel of a die repair shop, and of quality control, forklift drivers, crane operators, die change, cost reduction, and machine maintenance teams. Blanking machines and press line personnel work in two shifts ("white" and "yellow") and the change of day to night shift, and vice versa, takes place every week.

III. VOLKSWAGEN

1. The Company

General

Like Toyota, the Volkswagenwerk A.G. is a relative newcomer among the big automobile producers. The Wolfsburg and Braunschweig (Brunswick) plants were set up in 1938, Hanover in 1955, Kassel in 1957, Emden in 1964, and Salzgitter, the most recent of the German plants, in 1969.

Among the industrial concerns in the Federal Republic of Germany, Volkswagenwerk is in third or fourth place when taking turnover, added value and number of employees into consideration; and among German automobile manufacturers taking turnover, sales, added value and number of employees into consideration, it is in first or second place alternating with Daimler-Benz AG (Mercedes).

The product programme of Volkswagenwerk AG has developed from the original Beetle monoculture to include a wide range of models, which is complemented by Audi models in the German concern.

Distribution among the six plants of Volkswagenwerk AG results in a linked structure with which it is intended to utilise the advantages of high series production output:

- In the Wolfsburg plant, Golf, Jetta, Polo and Derby models and vehicle parts are manufactured and central functions are carried out;
- In the Hanover plant, mainly Volkswagen Commercials, LT (Light Truck) vehicles and 9-ton trucks produced jointly by Volkswagen and MAN (Maschinenfabriken Augsburg-Nürnberg) are manufacturered together with the engines for these vehicles;
- In the Braunschweig plant, mainly front axles for all plants are manufactured and central functions in tooling are carried out;
- Transmissions are produced in the Kassel plant. The Central Parts Store is also located here and reconditioning of Volkswagen exchange units is effected;
- Passat and Santana models as well as Audi models are assembled in Emden.

Volkswagen Germany employs a total of 114 522 people (in 1976: 97 422, in 1981: 120 071) of which almost 4 000 are apprentices, i.e. young trainees who combine practical training and vocational school attendance under the so-called "dual system" which is the core of German industrial training.

Industrial Relations

The framework of industrial relations in the Federal Republic is regulated by legislation, namely, the Enterprise Constitution Act of 1972 and the Co-Determination Act of 1976 which secure a high degree of worker participation at various levels of the decision-making process within the enterprise. These basic provisions are concretised and complemented by a host of collective bargaining agreements, both at the level of an entire industrial sector and, in the case of large enterprises like Volkswagen, of individual enterprises.

One of the most important of such agreements at Volkswagen is that the company has to inform the works council about plans regarding the introduction of new technologies and, in particular, that no staff member can be made redundant as the consequence of the introduction and application of automated production systems.

It has become obvious that under the influence of technological change, increasing expert knowledge must flow into the process of collective bargaining to enable the workers' representatives fully to exercise their rights to participation. The works council reacted to this requirement by establishing a planning committee in the 1970s, a system committee in 1980, a structure committee in 1982 and by increasing the number of full-time expert personnel appointed.

Training

Three basic types of training are distinguished: instruction (Unterweisung), initial professional training (Berufliche Erstausbildung) and continuing education and training (Fortbildung und Weiterbildung).

Instruction is understood as restricted training and education concerning working areas or industrial supplies, also conveying information to employees so that they are oriented regarding organisation and work sequences. The departments affected are responsible for such instruction. They effect measures themselves or together with other departments, e.g. the planners of the measure necessitating instruction, or they avail themselves of the services of firms of suppliers. The Training and Education Department can give organisational and pedagogic assistance, and possibly make instructors, lecture rooms and media available.

The Training and Education Department is responsible for training measures. As a rule these are a more structured form of learning with more emphasis on theoretical parts and with a degree of generality overlapping the field of the actual job in question. Differentiation between training and instruction is also important because of the varying degree to which they are affected by legal rights of co-determination.

Initial professional training or apprenticeship training, which is regulated by a body of legislation, administrative rules, as well as collective bargaining agreements, takes up the greatest volume in the Training and Education Department as far as quantity is concerned. It involves theoretical and practical training for school-leavers over a period of two and

a half to three and a half years. It is concluded by an official examination which is valid throughout the country. This form of training is characterised by a "dual system", partly public, partly private. There is co-operation between the public trade school which contributes approximately 20 per cent of a mainly theoretical nature and the company which contributes approximately 80 per cent, mainly of a practical nature. Within the Company, training is again divided into learning segments in training workshops and industrial practice. Training is generally not specific to the company or to a particular industry.

Upon completion of apprenticeship training, apprentices are usually employed on time wages and have the opportunity to be taken on to the salaried staff. Currently 5.5 per cent of the wage-earners and 18.6 per cent of salaried personnel were trained at Volkswagen. Overall 47.1 per cent of wage-earners and 84.9 per cent of salaried staff have had a completed professional training. Not all of these, however, were trained in the speciality corresponding with their actual job assignment.

Continuing training in the technical and commercial fields (Fortbildung) at Volkswagen AG is mainly but not exclusively carried out by the Training and Education Deparment.

In contrast to apprenticeship training, there are no legal requirements in the field of continuing training so that measures can be derived from the Company's objectives and needs and include social components of the Company's objectives. The industrial agreement on "Managerial principles" makes it the express duty of superiors "to maintain and improve professional capacity".

In 1982 in the fields of training were:

-- Engineering, work study, method study;
-- Vice-foreman/foreman training;
-- Economics, law, communications;
-- Languages,

382 courses were held for more than 6 000 employees. Output totalled more than 500 000 participants' hours of instruction. Approximately 2 476 employees attended external continuing training courses at public and private training institutions and at firms of suppliers in 1982.

Some divisions hold their own courses of continuing training. Particularly in the field of new technologies (electronic data processes, CAD/CAM, etc.), some divisions carry out continuing training for their own staff themselves due to the higher degree of flexibility and on account of having direct access to equipment in the introductory phase.

The extent of training and education measures effected by the divisions on their own responsibility is considerable. A quantitative comparison is available for the Production Division. The annual average for employees participating in the division's own training courses (major instructional courses and continuing training measures without preparatory measures) between 1980 and 1982 was 4 230 employees for an average of 23 hours. In the same Division, 4 170 employees participated in courses held by the Training and Education Department for an average of 96 hours each.

Another emphasis of continuing training is to improve co-operative and managerial conduct (Weiterbildung). With the exception of some selected, particularly internationally oriented management courses, all courses are effected internally by the Training and Education Department. In a central training centre for employees from all plants, the Central Continuing Education Section holds courses concentrated on the fields of management information and management training, and also courses on specialised subjects, such as company constitution. The Training and Education Departments in the individual plants hold courses of their own, to some extent in co-operation with the Central Continuing Training Section.

It is obligatory for certain target groups (e.g. management personnel, foremen) to attend certain continuing training courses; 154 further training and education seminars which were attended by 2 770 participants were held centrally in 1982.

The above Volkswagen training programme is offered during working hours at full pay. For employees interested in furthering their education there is also a wide range of other educational opportunities which they may take up in their free time. In this connection there is special emphasis on further education at evening schools and adult education classes. Volkswagen supports the work of adult education classes in its region, partly through material assistance but also by enabling Company facilities to be used and by making lecturers available. Wolfsburg has the largest college for adult education classes in the Land of Lower Saxony, ahead of towns with several times its population.

More than one-third of those taking paid educational leave in Lower Saxony are Volkswagen employees. Since 1974 there has been legal entitlement for employees to attend courses of their own choice in the fields of politics, or professional or general further education, for a maximum period of two weeks once every two years at full pay. More than 14 400 factory members participated in this scheme in 1983. Continuing their absence cost the company DM 17.9 million. Volkswagenwerk responded to this with a process of conceptional reorientation. The results of this were submitted in 1979 under the heading "Creative Training and Education". Creative was understood to mean fully utilising opportunities created by technological and social change.

By 1981 comprehensive reorganisation of the Company's training institutions created the structural preconditions for a new training policy. The departments for initial training, follow-up training and further training and education were combined with a newly-formed central training planning division into one "Training and Education Division" at the Company's second level of jurisdiction. A new divisional head from outside the Company was appointed, an educational scientist who was previously Rector of one of the largest German universities. In the same year, the Volkswagen Training Centre in Wolfsburg was opened, thus fulfilling the preconditions in respect of accommodation to facilitate expansion and better co-ordination of training work between the subdivisions.

In view of the continued acceleration of technical change and increasing short-term requirements, the Company report stresses that it remains the task of training to develop a strategy on the basis of principles

that meet the demands of the long-term and radical character of the present process of change.

2. The Hanover Plant

The field survey for the research report was carried out in the body shop for commercial vehicle production at the Hanover plant. This is Volkswagen AG's second largest German plant and at the same time the largest European commercial vehicle plant.

Work in Hanover began in March 1955. The first Commercial left the assembly line as early as March 1956. In October 1957 construction work began on a second building where engine production began in November 1958 to relieve the Wolfsburg plant. In 1962 work began on a foundry for casting alloys. After both buildings were extended a number of times, the plant encompassed a built-up area of 411 000 sq.m. in 1971 when it temporarily reached a final stage of construction. With a daily output of 1 200 Commercials and 7 500 engines, the highest production figures ever were reached in that year.

During the first oil price crisis, production figures for the Commercial dropped considerably. At the same time, the requirement for air-cooled horizontally opposed engines was lower due to the introduction of the new generation of models with water-cooled in-line engines from the Salzgitter plant. The area becoming available as a result of the drop in production was used to set up production of the newly developed LT model range which today covers the 2.8 to 5 t. gross vehicle weight range. Production of these vehicles began in 1975.

Within the framework of a model change on the Commercial (middle of 1979) the body shop was automated and modernised through intensive use of robots. New equipment and conveyor systems were also installed in the paint shop and assembly section.

Establishment of the Hanover plant began in 1955 with 372 employees. In the following year there was already a total of 4 954 who then began to produce vehicles. By 30th November 1971, the plant had 28 863 employees, thereby reaching the highest level with regard to the size of the labour force. In spite of the drop in personnel during the recession in 1974/75 and reductions due to the new models being converted to water-cooled engines which were largely manufactured in Salzgitter, the plant has over 19 000 employees and is thus still the most important employer in Hanover.

The breakdown at 31st December 1983 was:

-- 11 642 employees on standardised incentive wages
-- 5 259 employees on time wages
-- 1 894 salaried personnel
-- 719 apprentices.

The Hanover plant was considered to be a particularly suitable location for the research report because the automation of the body shop in 1978/79 had the character of a pilot project due to the fact that robots had been introduced on a large scale for the first time. For this reason the body shop

has already been the subject of other scientific surveys. This facilitates research continuity which also permits questions relating to time comparisons and longitudinal sections to be dealt with. In view of the period of time which has elapsed since automation in 1978/79, an evaluation of long-term effects can also be made.

In addition to the current automation of the oval assembly line in the body shop on which the research project centres, and the lines that are not yet automated -- in particular for LT assembly -- it was possible here to study three other stages of mechanisation situated nearby.

IV. VOLVO

The Volvo Group

In the course of about sixty years, Volvo has developed into Scandinavia's largest company and one of the hundred largest industrial enterprises of the world. Volvo started operations in 1926 and during the first years the annual production was a few thousand cars and trucks. At the end of 1983, Volvo employed just over 76 000 employees and had a turnover that year of some SEK 99 500 million. Markets outside Sweden accounted for more than 85 per cent of the value of group sales during 1983. During its expansive history, the Company has undergone a number of organisational changes.

During the 1960s, Volvo had a centralised and functional organisation and a large proportion of the turnover and profit came from the production of cars. In 1969, the Company adopted a product-oriented, divisionalised organisation. The aims of this included a higher degree of product specialisation, better result treasurement, shorter order routes and better control within the growing Company. The object was also to create better conditions for products other than cars, e.g. trucks and buses. The decentralisation was strengthened in 1972 as a result of a thorough reorganisation. Each major unit with product responsibility became an independent division, which involved not only providing these units with their own design and development resources, but eventually also with their own production resources.

In 1978, two industrial groups were formed. One was the Volvo Car Corporation, which embraced all car operations; the other covered all activities concerning commercial vehicles. In 1979, an industrial co-operation agreement on research, design and product development was signed with Renault, which, in 1980, became a minority shareholder in the Volvo Car Corporation. As of 1982, Volvo Group operations were concentrated mainly in the following areas of business and industry:

-- Transport equipment industry;
-- Engineering industry;
-- Food industry;
-- Energy.

In the 1983 organisation, Group Companies are divided into the following blocks:

-- Business Area Cars;
-- Business Area Commercial Vehicles;
-- Business Area Other Transport Equipment Industry;
-- Market Companies;
-- Business Area Engineering Industry;
-- Business Area Food Industry;
-- Business Area Energy;
-- Holding, Finance and Insurance Companies;
-- Service Companies.

The Group Headquarters is small, with some 100 personnel.

The Volvo Car Corporation

The Volvo Car Corporation employs 20 000 people, of whom 18 200 work in Sweden. The value of sales during 1983 was over SEK 17 000 million, which corresponds to about 17 per cent of the turnover of the Group. The Corporation's profit was SEK 3 563 million in 1983. The main organisation of the Volvo Car Corporation consists of the corporate executive management, five divisions and six staffs and administrative units.

The Volvo Car Corporation has plants in a number of countries. In Sweden there are three. The Torslanda Plant in Gothenburg, with some 10 000 employees, includes sheet-metal pressing, body assembly, body painting and final assembly of cars. The Kalmar Plant is a final assembly plant employing about 650 people, and receives painted bodies from the Torslanda Plant. The Olofström Plant employs over 4 000 persons and manufactures body and other parts, designs and manufactures equipment for body pressings, assembly and quality control of body parts and other components for Volvo and others. The Olofström Plant is dealt with in detail in the research report prepared for the CERI project.

Outside Sweden, Volvo has car assembly plants at Ghent in Belgium and Halifax in Canada. The Corporation's cars are also assembled in plants in Malaysia, Indonesia, Thailand and Australia.

Guidelines -- Industrial Engineering and Production Organisation

Volvo invested heavily in industrial engineering in the 1950s and 1960s. During the 1970s, great attention was devoted to the role of man in production, the physical surroundings, and socio-technical solutions, that is, the interplay between technology and human factors. Guidelines for industrial engineering and production organisation within the Volvo Group were established at the beginning of the 1980s. These Guidelines were based on the experience gained during the course of several years of systematic development work and constitute an important platform and support for further work. At

their core are two categorical statements made by Volvo's chief executive, Pehr G. Gyllenhammar:

> "The basic conditions for successful development of the Volvo Group consist of good profitability and financial strength. Other objectives will be impossible to attain unless these conditions are met."
>
> "Human beings make up the most important Company resource. It is possible to combine the creation of meaningful jobs with the achievement of high effectiveness. In today's society, both of these objectives must be met."

The Guidelines deal specifically with:

-- Knowledge of the business environment;
-- Interplay between product development and production;
-- Production strategy (i.e. the overall and long-term planning of production);
-- Design of production systems;
-- Industrial engineering and productivity improvement.

Industrial Relations

The forms of co-determination within Volvo have been developed over quite a long period, and employee representatives have participated in all the strategic decisions taken in recent years. Corporate knowledge among employees has grown step by step and today there is an expressed understanding of the Company, its business environment and the demands it makes.

An agreement on efficiency and participation between the parties of the Swedish labour market was signed on 15th April 1982. This expressed a joint willingness concerning the development of a company's efficiency, profitability and competitiveness, and the creation of conditions for employment, security and development in the work.

To supplement this central instrument, the management of AB Volvo and the trade unions reached a local agreement about eighteen months later based on a joint awareness that the Group organisation includes far-reaching decentralisation of powers and responsibility concerning various branch operations to subsidiaries with independent company managements and boards of directors.

The 1982 agreement on efficiency and participation deals particularly with:

-- Development of the work organisation;
-- Technical development;
-- Matters of the company's economy and resources.

The general policy as to the first of these is that: "Work organisation must be continually developed at all levels to increase the company's strength and competence and thus contribute to security and employment. Development of the work organisation also creates opportunities

to make use of the experience and knowledge of employees. Tasks, forms of management and control systems that are stimulating and show concern for employees should be sought to this end."

The agreement also states that the employers and the trade unions shall co-operate on the development of the work organisation and the work shall be performed so that it involves increased influence and responsibility for the employees involved in the work.

The agreement places considerable onus on company managers, in the words: "Competent and concerned managers are required to lead, develop and implement changes in the work organisation". As to the development of work organisation the agreement stipulates that "knowledge of the whole is required. Identification must be created around the operation and concept of the business".

Work Organisation

The development of the work organisation in Volvo can be described in two separate phases. Each phase can be identified with one particular plant at a time, but there has been a certain amount of overlapping. Irrespective of this, however, and of differences in the rates of change, each phase has its own characteristics derived from various initiatives taken in different parts of the Company in the mid-1960s.

During the first phase, the main interest was directed towards increased influence at the lowest operational level in the organisation, and terms such as job rotation and independent work groups became common. Few radical changes were made on either an organisational or technical basis. The need for change frequently had ergonomic roots.

When the Kalmar Plant was planned in 1971, executive management required an entirely new outlook to implement what was a completely new concept. The only way of achieving this was to marshall all the experience that had been gained at the pre-existing plants. The outcome was that, not only was the Kalmar Plant built, but communication was established between plants, projects and different disciplines.

So a new strategy came into being and the first phase was entered. Since 1971/72, a number of new projects have been started that are based on this earlier experience and on the active and expressed support of top management. However, no company can afford to go on "experimenting" on such a large scale, and the word is inapplicable to projects undertaken in the second phase, which involved the institutionalisation of the various changes.

Nine assembly lines have been built within the Group since the Kalmar Plant. All have been designed individually, keeping pace with the ever changing demands of production technology.

Training

Training in the Volvo Car Corporation is carried out today in a highly decentralised form and largely as a strategic instrument in organisation development. The Group joint training unit was decentralised at the time the Volvo Car Corporation was formed. The decentralisation of the training function was based on the following principles:

1. General decentralisation of the organisation on business grounds;

2. More clearly expressed line responsibility for development matters;

3. Greater integration of training and other development activities.

The decentralisation involved the distribution of training resources through the Group and today very few people at the Centre are mainly occupied with training. Responsibility here is for co-ordination, information and the exchange of experience. Higher-level management training, though, is still carried out centrally.

Volvo Olofström in Society

The Volvo Olofström Plant (established in 1969) is one of several Volvo units involved with the manufacture of automobiles. Its principal commitment is the production of pressed parts for the bodies (karosseridelar) of the different models.

The production takes place in four big buildings in Olofström with nearly 300 presses with capacities from 100 to 2 000 "presskraft". The process in the plant is organised for the production of a long series of pressed parts for automobile bodies. No other plant in Sweden has such a large-scale production of pressed sheet details.

The Volvo Olofström Plant is located in the Municipality of Olofström in the County of Blekinge. It totally dominates the industrial life in this area which is typical of the old industrial environment in Sweden. The total number of employees is around 4 000; 3 000 are blue-collar and 1 000 white-collar workers.

V. RENAULT

Historical Background

Renault Frères, the Company founded by Louis Renault in 1898, was formed to manufacture automobiles and to exploit patented inventions, including direct-drive transmission, which was a major innovation at the time. On the eve of World War I, Renault had 5 200 employees, and production in 1913 came to 10 000 vehicles. In 1939, with a workforce of 36 000, Renault produced 20 000 trucks, 43 000 passenger cars and light transport vehicles, engines (particularly for the aviation industry), self-propelled railcars, and

other equipment. At the end of World War II, during which it had been requisitioned, all but 20 per cent of the company was destroyed.

The Ordinance of 16th January 1945 confiscated Renault assets on behalf of the nation, and established La Régie Nationale des Usines Renault (the Renault Organisation). The Ordinance specifies that Renault, "in the areas of financial administration and accounting, follows the generally accepted practices in use in industrial and commercial companies; its financial resources are provided by the sale of its products and by recourse to customary means of borrowing", and that it "is liable to taxation under the ordinary system of law". This means that Régie Renault is subject to the same laws, managed along the same lines, and encounters the same financing, personnel, production and growth problems as any private sector company of its size.

The initial years after Régie Renault was set up were devoted to reconstructing its industrial potential. Renault was open for advanced technical solutions, developed successfully, and soon became France's leading exporting company.

At the beginning of the 1980s, Renault Group operations were structured around four large divisions, two of which directly served the transport market (Automobile, and Commercial Vehicles Divisions), as well as the Division for the Development and Production of Automated Systems and the more diversified Manufacturing Companies Division. A Financial Division encompasses all financing and investment companies.

In 1982, Régie Renault, along with its subsidiaries, was one of the leading European industrial groups, and the number-six automobile producer in the world. The total workforce in France and abroad came to 217 269 employees, including 158 202 in the automobile sector (111 878 in France). Total sales came to 104 145 million francs, including 76 272 million generated by automobile operations. Abroad, Renault passenger cars are assembled and produced in 22 countries. The Company sells over half its production abroad, in 150 countries.

Industrial Relations

Régie Renault was the first French industrial company to have a Works Council. During the fifties, it introduced a "contractual policy" which was the framework for company agreements between management and union. These agreements have often had a strong influence on industrial relations in France.

In recent years, considerable changes have occurred in French laws and regulations in the area of industrial relations. One of the implications for Renault has been the setting up in 1983 of "expression groups" in workshops and offices.

The role of the Works Council has also changed. Since 1982, the law provides that "the Works Council is informed and consulted prior to any major project to introduce new technologies, if these are liable to have an impact on employment, qualifications, pay, training, or working conditions of employees".

In order to enhance workers' participation in considering the ongoing changes in industry and in industrial relations, their impact, and the choices enabling greater preparedness and control over the various factors which condition the company's future, a new programme for employee involvement was created in 1983: the MIDES project (Mutations Industrielles et Dynamique Sociale). All the labour unions are participating in this, which illustrates the commitment to communication, to co-operation and consultation, and to extending responsibilities which Renault intends to develop so that each person, at his or her level and in his or her sector, participates in the Company's acivities and policy formation.

During the first (exploratory) phase of the MIDES project seven working groups, composed of equal numbers of members named by management and by the labour unions, held regular meetings to draw up a survey of the Company's constraints, opportunities and alternatives in seven areas:

-- Towards new industrial systems;

-- Industrial change in production;

-- Industrial change in design and administration;

-- Changes in products, new technologies and changes in industrial relations;

-- Renault and competitiveness;

-- Changes in industrial work and changes in industrial relations;

-- Geographical decentralisation, new technologies and changes in industrial relations.

In June 1983, these working groups reported to a convention attended by 400 people representative of the Renault workforce and the labour unions. This also gave the Chairman of the Board a chance to reaffirm the importance he attached to developing this process of co-operation and consultation in the context of the Company's current and future challenges.

The convention concluded with agreement on seven topics for further, in-depth study:

-- The basic production unit;

-- Company structures;

-- Training;

-- Employment and organisation of working time;

-- Nature and means of introducing new technologies;

-- Company economics;

-- Communications and the "MIDES spirit".

These joint labour and management groups, which were joined by outside experts nominated by group leaders and by the labour unions, have been working on these topics since October 1983.

The MIDES programme fits into the framework of Renault's overall industrial relations project whose principles were presented by the Chairman of the Board in January 1982: "Industrial relations policy must achieve a synthesis of essential industrial requirements and essential human requirements, by meeting two objectives: giving the personnel their due and giving the Company its due. The industrial relations climate then depends on a consistent attitude that derives from considering corporate development and human development concurrently. Neither can advance without the other, because neither can be built without the other."

Recent Technological Developments

Since the mid-1970s, there has been a considerable acceleration in the rate that automated design and manufacturing facilities have been introduced in the Company. Despite the rapid and intensive implementation of new technologies, automation levels vary considerably among different manufacturing sectors: foundry, stamping, body-assembly, machining shops and painting have all been extensively automated. Similarly, materials handling and storage, particularly for large, heavy parts, are sectors in which automation is making rapid progress. On the other hand, final vehicle assembly and the assembly of mechanical systems involve a wide variety of tasks, and continue to pose a number of problems, particularly in terms of manipulating parts, feeding machines, appropriate tools, and developments in assembly methods.

The impact of the technological changes in Renault can be summarised as follows:

-- Technological change has resulted in far shorter working time for each vehicle produced, but the cost of paying back capital investments represents an ever-increasing share of production costs; however, quite often, and particularly in the case of robots, new equipment is not replacing workers so much as less sophisticated automated equipment;

-- There is a very sharp improvement in productivity and quality in these new production systems. A very significant decline in production costs is observed, for instance when robots are utilised in welding. Because of their reliability and precision, such equipment also brings about a considerable reduction in the percentage of reworking required, in comparison with conventional equipment;

-- In terms of skills and qualifications, we are witnessing a transfer in functions from direct manpower to indirect manpower. There is a significant increase in employees in the service and maintenance sectors, particularly during the stage new technologies are installed and started up. This quantitative increase is accompanied by a corresponding rise in qualification levels;

-- The complexity and sophistication of this equipment calls into question the ever-increasing specialisation of work, which was one of the bases of "scientific work organisation". In highly automated facilities in which several new technologies are used, there has been a shift from the "one man-one machine" organisation concept to the concept of "one group-one system";

-- The need to maintain facilities at the highest performance level, and the need constantly to develop technological potential have led to greater co-operation between production departments and other areas "upstream" from the production function;

-- Technological change has by no means been limited to production shops and design departments. This change has an impact on all Company functions, which in the near or medium term, and each in a specific way, will be called into question and will have to adapt and undergo a transformation.

Work Organisation

In the beginning of the 1970s, Renault started a programme with the twofold objective of reducing the constraints of repetitive work tasks and creating a growing proportion of work stations with enriched content for workers. The technological changes have led to different forms of work organisation and there is no single organisational model valid for all workshops.

In plants where new organisation models have been implemented, the following main features can be observed:

-- The formation of small groups of workers (between five and ten) jointly responsible for operating an entire installation, or at least a part of the facility. These groups generally consist of "AP" (production agent) and "P" (professional) workers, in varying proportions, depending on each plant and the degree of technology incorporated;

-- Multiple skills within these groups: taking account of the size and complexity of these facilities, workers perform multiple functions and rotate tasks within the group. As already mentioned in connection with the impact of technological change, the aim consists in achieving complementarity within the group, rather than merely bringing together a set of highly-specialised skills;

-- Job enrichment: operating and monitoring these large-scale automated facilities involves not only quality control and machine adjustment operations under normal operating conditions, but also trouble-shooting, standard maintenance and corrective action in the event of sub-nominal equipment performance. This is not merely a broadening of tasks, but rather provides job enrichment;

-- Higher employee qualification levels: there is a visible shift in the qualifications of employees working in the most technologically advanced facilities.

The set of factors influencing qualifications is more complex, but on the whole the change in production systems is already bringing disciplines closer together; new technical disciplines are emerging; and new careers are beginning to take shape. This may be seen as an opportunity to be grasped in order to optimise career management, training and technical requirements.

-- Changes in supervisory functions: supervisors of work groups composed of employees responsible for running and maintaining facilities require qualities different from those traditionally sought in line supervisors. In addition to the traditional task of leading and supervising employees, they must perform the function of managing technically sophisticated systems, which requires special training and higher skills.

Training

Training has always occupied a major position in the Company, which very early on developed an active training programme to keep pace with its development, meet the requirements of technical change and encourage the career advancement and social promotion of its employees.

Training programmes reach all functions and sectors in the company, and involve all personnel categories in their career development. Renault policy in the area of training has led the Company gradually to develop a training system and organisation capable of efficiently meeting, in a balanced way, the needs arising from the Company's development and employees' individual aspirations in terms of instruction, higher skills and promotion. Another major feature of Renault training is its decentralisation at the level of the central departments and plants, in terms of developments in training requirements, planning and actual instruction.

It should be pointed out that Renault has always gone far beyond the legally required minimum training budget (1.1 per cent of the payroll). In 1982, actual training expenditures came to 333 million francs, or 3.3 per cent of the payroll. Approximately 80 per cent of this training was provided by the Company's internal resources. Over the past five years, there has been a very sharp, continuing increase in both the number of trainees and total instruction hours in high technology areas (automation systems and robotics).

In determining training strategies and drawing up training plans, industrial change as a whole has always been taken into account -- and not merely technological change. Yet it is clear that the massive introduction of new technologies, which thoroughly transform product design, forms of analysis, relations, management methods and work organisation, particularly when new vehicles are released, has a considerable influence on the orientations and contents of training programmes.

Another strategic aspect of Company policy consists in developing training structures and capacities in each plant. Increasing the number of

"on-the-job" instructors in each plant, and raising the participation of the entire hierarchy in determining and conducting training operations geared to each plant's specific policies will thus satisfy the needs arising from the development of new technologies and by organisational changes. As a direct application of the collective bargaining agreement cited at the beginning of this summary, each plant develops its own strategy to ascertain training requirements, as close to the individual level as feasible.

Training in Advanced Technologies

The massive introduction of automated systems in workshops and offices in the mid-1970s caused a major upsurge in training requirements in the automation area, and made it necessary to set up a specialised service assigned to forecast, enable and facilitate the adaptation of personnel concerned by the installation of automated equipment. This Advanced Technologies Training Service (SFTA) performs this assignment at the central company level, but training operations in plants are carried out by local centres as well as by outside educational institutions.

The successive stages in training can be summarised as follows:

-- Technology: the basis of any automated system; training was introduced as early as 1969 in pneumatics, electronics and electrical engineering, and more recently in micro-electronics;

-- Hardware: this justified specialised training programmes which began in 1975 with the development of mini-computers, micro-processors, programmable controllers and the first robots;

-- Complete systems: 1977 saw the appearance in workshops of advanced robots, computerised numerical control machines, and CAD (these are systems that include several types of equipment, and which use a variety of technologies);

-- Flexible facilities and workshops: encompassing several of the systems introduced in the early 1980s.